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ORAL TRAINING LESSONS

IN

NATURAL SCIENCE

AND

GENERAL KNOWLEDGE,

EMBRACING THE SUBJECTS OF

ASTRONOMY, ANATOMY, PHYSIOLOGY, CHEMISTRY, MATHEMATICAL GEOGRAPHY, NATURAL PHILOSOPHY,
THE ARTS, HISTORY, DEVELOPMENT
OF WORDS, ETC.

INTENDED FOR

TEACHERS OF PUBLIC SCHOOLS

AND ALSO

FOR PRIVATE INSTRUCTION.

BY

H. BARNARD,

PRINCIPAL LINCOLN SCHOOL, MINNEAPOLIS.

A. S. BARNES & COMPANY,
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1871.

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INTRODUCTORY AND EXPLANATORY.

It need hardly be stated that the Author's object in this work is to present a concise but comprehensive course in the most important Natural Sciences to those who have not the means of purchasing separate works upon each, and who may not have had the opportunity of acquiring a knowledge of them during their school-days.

But this is not the only object. The information is all arranged in the probable course that a lesson would take, were the teacher imparting it in the school-room.

Not only is the material furnished and arranged in this manner, but the process of developing new words and applying them has also received particular care and attention.

The mode of treating inattentive or idle pupils is also shown during the course of the lesson.

By a careful previous study of the lesson, any Teacher of ordinary ability may very successfully give either of the lessons of the course.

Perhaps none of the lessons will take the exact course here given. You must inevitably follow where the pupils' answers lead you; but you MUST, at the same time, LEAD their thoughts in the general direction indicated.

The six prominent features of these lessons are:

1st. Elliptical Answers given by all in concert.

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2d. Individual Questions and Answers.

3d. Complete Statements by Individuals as the lesson progresses.

4th. Analogy and Familiar Illustrations.

5th. The writing of all new words on the blackboard, these words being in SMALL CAPITALS.

6th. A rapid general review at the close, with the object of putting the whole lesson in such a form as will connect all its parts so as to form a COMMENCEMENT and a TERMINATION.

The elliptical answers must NEVER be a mere GUESS. Only one word should be able to supply the ellipsis. It should never be PART of a word. Thus, instead of saying (see Lesson xxxviii.) "some bodies are simple and others are com . . . . *pound*," we rather say, "some bodies are simple and others are . . . . *compound*." If it is not entirely by the scholar's own exercise of thought, the object of the lesson is not attained; nor is it, if the answer is a mere guess.

At the word immediately preceding the ellipsis the rising inflection of voice should be used to indicate when you wish a word answered. In all individual questions require the hands to be raised by those who can answer, and call no one. Whenever a question is asked, no more than one should be allowed to speak; but at an elliptical answer, require every voice in the room to be heard.

Remember that the QUESTION pumps up the water from the well, but it requires the ELLIPITCAL ANSWERING to lead it on in the proper direction.

All words in *italics* are pronounced by scholars; those in ordinary letters or capitals are to be given by the Teacher.

Write all new words, or those in small capitals, on the black-board.

Never use a term that has not been well explained, and whose meaning is not clearly comprehended by the pupil. Anglo-Saxon words are always the best.

Never do injury to the sensitive feelings of the pupil by saying, "NO; YOU ARE WRONG," but train him, unconsciously, by the natural process, to that which is correct.

This fact deserves prominence: A lesson is never GIVEN till it is RECEIVED.

Be careful, as each point is gained in the lesson, to require some one, or all, to give the full and complete statement in its simplest form, before going on to the next point. This should be done at the end of each paragraph, at least. These statements are omitted in nearly all the lessons given in this volume, as it would make the work unnecessarily voluminous. A sufficient number of examples will be found throughout the course to indicate the manner in which it is done.

When any considerable number of scholars fail to do this, cause them to quietly take out their slates and write it from the dictation to some attentive scholar. The younger the scholar who dictates it, the better the effect. Then cause them to read it from their slates, and afterwards to state it, as required at first.

It is always preferable to have ONE POINT of the lesson well understood than to go over the ground of a whole lesson without any distinct idea of the several steps contained in it. QUALITY FIRST; QUANTITY AFTERWARDS.

Each pupil should also, at the close of a lesson, be able to make all the statements contained in it successively.

As often as once each week, the material contained in some previous lesson should be made the subject of a composition to be written by all. This will be found a most profitable and interesting work. Let them introduce all other facts or conclusions connected with their subject.

NORMAL SCHOOLS

Are now being established in every part of the United States and the British Dominions for the express purpose of creating good Teachers from good Scholars. Teaching, being an Art, as well as Carpentering, Weaving, Mining or Agriculture, requires a preparatory apprenticeship. If the present work gives even a very limited assistance to the work of furnishing the Teacher with the material and the manner of imparting, the Author will consider that his efforts are not without success.

Not an unimportant part of its mission will be its use at the family fireside. One may be selected to act as Teacher, and conduct the lesson with the other members of the family as pupils. This will be found a most gratifying and instructive employment during otherwise unoccupied time.

The work, however, is designed particularly for public schools. The lessons may be conducted with all the scholars together, which is preferable, or with a large class composed of all who are capable of answering.

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ORAL TRAINING LESSONS.

LESSON I.

NATURAL SCIENCE.—CLIMATE: ITS ELEMENTS.

Raise hands all who can tell me what is meant by Climate. Does no one know? We will see.

In countries where the sun shines perpendicularly, that is, directly over . . . . . *head*, we say that they have a very hot . . . . *climate.* Then when we speak about climate, we mean the . . . . *heat*, or . . . . *cold.* Now raise hands those who know a word that means heat or cold. When we speak of the heat or cold of the air, for example, what word is generally used? George? . . . . *Temperature.* That is correct. Let me hear this word from all . . . . *Temperature.* Again . . . . *Temperature.* The temperature of the air, then, means whether it is hot or . . . . . *cold.* Annie, repeat that sentence. (She repeats. If she cannot, from inattention, cause her to leave her seat and write it on the slate two or three times after asking some one else.) Eddie, if I speak of the temperature of the water in the river, to what do I refer? . . . . *You mean whether it is hot or cold.* Correct.

Now, when the air is very hot, the temperature is said to be very . . . . ? I will tell you. It is said to be very HIGH. When the air has a HIGH temperature then you mean that it is very . . . . *hot.* What would it mean to say it is very low? Hands up. Willie? . . . . . *Very cold.* Make the whole statement . . . . . *By a low temperature we mean that it is very cold.* Very well, indeed. You would say, for instance, that ice has . . . . . *a very low temperature*, and that red hot iron has . . . . *a very high temperature.* What would you say of the temperature of melted lead? Hands up. Fred? . . . . . *Melted lead has a very high temperature.* When you speak of climate, then, one thing that you mean is the . . . . *temperature,* that is . . . . *the heat or cold.*

Now, does it mean anything else? Suppose that it seldom rained, what then? . . . . . *It would be a dry climate.* Yes, and climate will also mean whether it is . . . . . *dry or wet.* I also wish you to give me one word for this. Hands up. What, none? The word I wanted was MOISTURE. All repeat together . . . . *moisture.* Here, then, are two things. They are . . . . . *temperature and moisture,* which form the . . . . *climate,* of any . . . . *country.*

There is something else meant when we speak of climate besides . . . . *temperature and moisture.* What is it? Did you ever hear of a windy climate, or a stormy climate? . . . . *Yes, sir.* Then the third thing in the climate of a country is . . . . *the wind.* We will call it PREVAILING WINDS. All answer . . . . . *prevailing winds.* Libbie, will you give us these three things? . . . . *Temperature, moisture and prevailing winds.* What about them? . . . . *They form the climate of a country.* Then you make the complete statement, Charlie. (He makes it.)

Now, in the next place, since these things make up a climate, they may be called its . . . . ? Well, let us see. The sounds that compose a word are called its . . . . . *elements.* Correct, and those things that compose a loaf of bread could be called its . . . . *elements.* What are the elements of bread? Alice? . . . . *Flour, water, salt and yeast.* Raise hands all who can give me the elements of mortar. Frank? . . . . *Lime, water, sand and hair.* Of this book, Cora? . . . . *Paper, ink, cloth and leather.* And raise hands all who can tell me the elements of climate. You may tell me, George. . . . . *Temperature, moisture and prevailing winds.* And the elements are those things of which anything is . . . . *made up,* or . . . . . *composed.* Before going on to the next point we will revise what we have said. The climate of a . . . . *country,* consists of, 1st, ... *temperature,* which means the . . . . *heat or cold.* 2d, ... *moisture,* or whether it is . . . . *wet or dry;* and 3d, ... *prevailing winds.* When it is cold the temperature is said to be . . . . *low*, and when hot it is said to be . . . . . *high*. Sam, give me an example of this . . . . *Ice has a low temperature and steam has a high temperature.* Yes, but you might have omitted the first word temperature. Repeat without using it. (He repeats.)

Now a country which is not too warm in summer nor too cold in winter, has what kind of a climate? . . . . . *Temperate.* (If not known, carefully tell it.) A temperate . . . . *climate*, means one that is neither . . . . *too hot nor too cold.* Kate, repeat that. (She repeats.) But when it is very cold in winter and very hot in summer, the climate is said to be . . . . ? I will tell you, if all listen attentively. It is said to be EXTREME. All repeat. It is said to be . . . . *extreme.* Again . . . . *extreme.* What does an extreme climate mean? Fannie? . . . . *One that is either too hot or too cold.* Yes, but I want the complete statement . . . . . *An extreme climate is one that is either too hot or too cold.* A temperate climate that is not too wet and stormy is also called SALUBRIOUS. All repeat . . . . *salubrious.* This word means several things. When we say a climate is . . . . *salubrious*, we mean that it is neither too hot nor too . . . . . *cold*, which in one word would be . . . . *temperate*, and that it is not too . . . . *wet and stormy.* It might not even rain very much, but if it was foggy and damp would it be salubrious? . . . . . *No, sir.* Raise hands all who can give me another word like salubrious? I will give you one. GENIAL. All answer . . . . *genial.* A genial or . . . . *salubrious climate*, is one that is in every way . . . . . *fine*, or . . . . . *agreeable.* Fred, repeat that last sentence. (He repeats.)

Now all answer promptly. By the climate we mean three . . . . *things.* 1st, ... *temperature*, or the heat or . . . . *cold*, 2d, ... *moisture*, or the state of being wet or . . . . *dry*, and 3d, ... *prevailing winds.* Then the temperature may be . . . . *high* (gesture in a case like this), or . . . . *low*, which would mean . . . . *hot or cold.* Since these three things make up, or . . . . *compose*, climate, they may be called its . . . . *elements*, When a climate is too hot or too . . . . . *cold*, it is said to be . . . . *extreme*, but if not, it is . . . . *temperate.* If it is temperate and also not too stormy or moist, you would say it was . . . . *salubrious*, or . . . . . *genial.* Or even if it has extremes, if it is conducive to good health we speak of it as salubrious and genial.

LESSON II.

Adapted to Young Scholars.

NATURAL HISTORY: HABITS OF THE CAT.

Now all sit upright and attend. When you are LOOKING and LISTENING then you are . . . . . *attending.* All answer promptly.

All animals do not live in the same . . . . *way.* A horse does not get its food as a dog does, and a hen and a duck do not both live in the same . . . . *place,* or . . . . *manner.* But every animal is exactly fitted by the Creator for its way of . . . . *living.* Willie, repeat that . . . . *Every animal is exactly fitted by the Creator for its way of living.*

Now all may raise hands who can give me a better word than fitted. Lizzie? . . . . . *formed.* Very good. I now want another. Hands up. George? . . . . *arranged.* Yes, another; Frank? . . . . *fixed.* Yes, all these words would do. We will repeat them in order. Every . . . . *animal,* is exactly . . . . *fitted,* or . . . . *formed,* or . . . . *arranged,* or . . . . *fixed,* for its way of . . . . . *living.* But I will tell you a better word. It is ADAPTED. All pronounce it together . . . . *adapted.* We will use this word through the lesson. All animals are exactly . . . . *adapted,* to their way of . . . . *living.* You may all now try and think of one word that means ways of living or doing anything. Can you not think of such a word? Let us try if we can find one. A boy who comes in late to school every day, we say, has formed a very bad . . . . . *habit.* And a dog that barks at every one who passes has also formed a very . . . . *bad habit.* A boy who tells untruths has an exceedingly . . . . *bad habit.* Now we will use this word instead of ways of living. Every . . . . *animal,* is exactly . . . . *adapted,* to its . . . . *habits.* All who can repeat it, raise hands. (All should be able to, if you have successfully given the lesson so far.) Jane? .... *Every animal is exactly adapted to its habits.* Correct.

We are to speak to-day of the habits of the cat. What does the cat eat? Hands up. Annie? ... *Mice.* Susan? .... *Birds.* William? .... *Weasels and squirrels.* John? .... *Rats.* That will do. We may say all kinds of small .... *animals.* They are her food. There is a better word than food. You may all give it if you can ..... *prey.* That is right. (If they do not know it, tell it.) Would you call a sheep's food its prey? .... *No, sir.* But a cat's food is called its .... *prey.* And you say that her prey consists of all kinds of small ..... *animals.* These animals are very quick, and the least noise would .... *frighten them away.* And such animals as mice generally come out of their nests in the night, or in a dark cellar or closet. What do you think the cat will require first of all, if she has to catch her prey in the dark? Hattie? .... *She will require good eyes.* Very well answered. She must have good, sharp .... *eyes,* so as to be able to see even where it is .... *dark.* Willie, repeat that. (He repeats.) Now all together again. All animals are found to be exactly .... *adapted,* to their .... *habits.* The cat, having to catch her .... *prey,* in the .... *dark,* must be adapted to that, and must therefore have good .... *eyesight.* Must she have anything else that you can think of? Jennie? .... *She must be able to run.* Well, I do not know whether that will be very necessary or not. Listen to me. Would a sheep's feet do for a cat even if she could run fast? .... *No, sir.* I think not. She must have very .... *soft feet,* so that when she ..... *walks* (accompany these ellipses by gestures,) she may make no .... *noise.* For if she made as much noise as a sheep she would .... *frighten the birds or mice.* We have now found two things that she must have. Fred? .... *Sharp eyes.* Next? ..... *Soft feet.* Who will state this? Willard? .... *The cat must have sharp eyes and soft feet.* Good.

Now we will try again. She creeps up very softly as near as she can get to a .... *bird,* or a .... *mouse,* and then she crouches down and waits till it hops a little .... *nearer,* and while it is not looking she makes a great .... *spring,* or . . . . . *leap*, and jumps right upon it. But if she had sheep's feet, what then? . . . . *She could not catch the mouse.* Another word for catch. She could not . . . . . *seize the mouse.* In order to enable her to seize it, she must have sharp . . . . *claws*, upon her . . . . *feet.* But if you look at a cat's paw you see no claws. How is this? A sword is kept in a . . . . *case*, or . . . . *sheath.* And if a cat's claws are to be kept . . . . *sharp*, they must also be put into . . . . *cases.* Are they? . . . . *Yes, sir.* And if we just pull one of her whiskers, we see all her . . . . . *claws*, displayed at once. Then her claws are kept sharp by means of . . . . *sheaths*, or . . . . *cases*, between the cushions of her . . . . *feet.* These cushions are under her . . . . *feet*, so that she may make no . . . . *noise*, when she . . . . *walks near a mouse.*

In the next place, after she has caught her . . . . *prey*, she must have proper teeth so as to be able to . . . . *tear it.* Teeth like a sheep's would not do for the . . . . *cat.* Her teeth must be very . . . . *sharp.*

Now all answer. In order that the cat may be . . . . . *adapted*, to her . . . . *habits*, or . . . . *way of living*, she must be provided with, 1st, ... *good eyes;* 2d, ... *soft feet;* 3d, ... *sharp claws*, to hold or . . . . *seize her prey;* 4th, to keep her claws sharp, her feet must have . . . . *cases*, or . . . . *sheaths;* 5th, she must have good sharp . . . . *teeth*, in order to . . . . *tear her food.*

——o——

LESSON III.

THE FORM OF THE EARTH: PROOF BY CIRCUMNAVIGATION.

We are to speak to-day of the Form or Shape of the Earth. How many know its shape? I see several hands up. Willie? . . . . *Round.* Round like a cent? . . . . *No, sir; round like a ball.* Round like a stove pipe? . . . . *No, sir; round like a ball.* A ball is also called a . . . . *globe.* What word will mean "like a globe?" George? . . . . . *globular.*

Right. I will write this word on the blackboard. All answer . . . . . *globular.* This word means . . . . *like a globe.* There is another word which means like a sphere. What is it? . . . . *spherical.* The earth then is round . . . . *like a ball,* or . . . . . *globular,* or . . . . *spherical.* Now do you believe this? If you go outside and look, can you see that it is round? . . . . *No, sir; it is flat.* This boy thinks the earth is flat. Does any one else think so. No one? Then you think it is . . . . . *globular.* Why? Have you any reason? What good is there in telling me it is round or globular, if you cannot prove it. This boy who said flat, answered as he naturally believed it is. And for thousands of years people lived and died without knowing any better than this. A long time ago it was thought to be as it looks, that is . . . . *flat.* And boys and girls often asked their parents how far they could . . . . *go,* before arriving at "the end of the earth." They felt curious to know if there was any place, away off, where you could "jump off,"—a regular "jumping-off place." And then some very inquisitive boy like Sam here, would ask what it rested on, or what it was built upon. But their parents could not tell anything about these things. Well, Sam, I see your hand up? . . . . *What does the earth rest on?* We will see presently. Don't be too much in a hurry. Some wise philosophers taught people that the earth was built on four great pillars. Others that it was carried on the back or shoulders of a god whose name they called Atlas. All repeat this name . . . . *Atlas.* Then others said the land was like a great raft, and floated upon the . . . . *water.*

Well, Charlie, what is it? . . . . *What did they think the pillars rested on, or the god, Atlas, or the water?* (If such a question is not asked, you ask it.) Oh! that was the great question which they could never . . . . *answer.* We have just said that the earth was not flat at all, but . . . . *round like a ball,* or . . . . . *globular,* or . . . . . *spherical.* I heard some girl say *sperical;* all answer it correctly . . . . *spherical.* Now I am going to tell you how we know this. (Use the map of Hemispheres or a globe here.)

In order to go to India, the people of Europe had to sail . . . . *round the continent of Africa,* or round the . . . . *Cape* *of Good Hope*, and then across the . . . . . *Indian Ocean.* But about four hundred years ago, all repeat, about . . . . *four hundred years ago*, a man named COLUMBUS, who lived in a city of Europe called Genoa, thought that he could get to India in another way in a ship. This man's name was . . . . *Columbus;* he lived in . . . . *Genoa*, about . . . . *four hundred years ago.* What did I say about him, Lizzie? . . . . *He thought he could get to India in another way in a ship.* Yes, Columbus believed that the earth was round like a ball, or . . . . *globular*, or . . . . *spherical.* Very few others believed this. No one in Genoa believed it.

But Columbus said to himself, "now if the earth is actually globular, if we sail round the other way, that would be . . . . *West*, we will get to India just as well. And I think it is a shorter way than going round the . . . . *Cape of Good Hope.*" What was it that Columbus thought, Fannie? . . . . (She repeats.) So he went to his King and asked him to fit out a good . . . . *ship*, and let him go and try to find another . . . . *way to India.* Do you think the King did so? No, he only laughed at Columbus, and thought he was mad. He said, "How ever could you get round the other way? Why your ship would fall off." We will see in another lesson why it is that a ship does not fall off in going round the . . . . *world.*

But Columbus had to go away from his own country, from . . . . . *Italy.* He went to this country . . . . . *Spain.* There the King and Queen, FERDINAND and ISABELLA, gave him several ships to go with, and fitted him out for the voyage. What a glad day that was for Columbus! He thanked . . . . *the King and Queen*, and his ship . . . . *sailed.* They went away many hundreds of miles to the . . . . *West.* Sometimes the men got afraid that they would get to the end of the world and fall over! For some of them believed the earth was . . . . . *flat.* At one time they threatened to throw Columbus overboard and go back to . . . . *Spain.* But he cheered them and they sailed on, and at last one day a man upon one of the masts called out that he could see the land! They had, before this, seen branches of . . . . *trees*, and drifting wood, so that they knew they were near . . . . *land.* Then Columbus was sure he was coming near to . . . . *India*, and he felt very . . . . . *glad*, to think what a great discovery this . . . . *would be.*

But as they came near the shore, they saw that the people were not like those who lived in India. They had come to a very strange place that no European had ever seen before. Who can tell me what country it was? George? . . . . *America.* Correct. Afterwards men sailed across from Europe westward, all the way to . . . . *India*, by going round . . . . . *South America.* And now we can travel all round the world in about two months. Since we can start and keep on in the same . . . . . *direction*, and at last arrive where we . . . . *started*, the earth must be . . . . *round.* But if it was like the stove-pipe we could still sail round it. How are we to know that it is round like a ball? We will prove this in another lesson.

Now all answer rapidly. Long ago the earth was supposed to be . . . . . *flat.* But we now know that it is round like a . . . . *ball*, or . . . . . *globular*, or . . . . *spherical.* The first man who acted on this supposition was? . . . . *Columbus*, who was born in . . . . *Genoa*, about . . . . *four hundred years ago.* He believed it to be . . . . . *globular*, and attempted to go to . . . . *India*, by sailing to the . . . . . *West*, instead of round . . . . . *Cape of Good Hope.* But did he reach India? . . . . . *No, sir.* Instead of that, he . . . . *discovered America*, which is between . . . . . *Europe*, and this continent . . . . . *Asia* (pointing to Asia). Since the time of . . . . *Columbus*, men have sailed completely . . . . *round the world*, thus proving it to be . . . . *round.*

LESSON IV.

PHYSIOLOGY: ORGANS AND FUNCTIONS.

I see one or two boys not sitting in an upright . . . . . *position.* Can they attend properly? . . . . *No, sir.* Then all sit . . . . *upright.*

Our bodies consist of many different . . . . . *parts*, and these different parts have all different things to do. The hands have not the same work to do as . . . . *the feet*, (pointing downwards to the feet, using appropriate gestures wherever they will assist,) and the feet do not have the same kind of work as the . . . . *eyes*. But every part of the body has something to . . . . *do*. And, unless it is diseased, every part does its own . . . . . *work*. Now I want to see whether any of you can tell me a name for a part of the body which does any particular work. What does the eye do ? . . . . . *It sees*. Then you could call the eye an . . . . . ? There is a particular word used for this, which I will give you. Raise hands all who will try and remember it. Well, hands down. It is ORGAN. Let me hear all repeat this word . . . . *Organ*. Again . . . . *Organ*.

The eye or ear then could be called an . . . . *organ*. The eye is the organ of . . . . . *sight*, and the ear is the organ of . . . . *hearing*. Raise hands all who will repeat this. (If there is one who has the ability to do so and cannot, owing to inattention, make him stand and write it on his slate, while some smaller boy or girl dictates it to him.) Ella, you may state it . . . . *The eye is the organ of sight, and the ear is the organ of hearing*. Fred, let us hear that from you also. (He repeats.) And the nose is the . . . . . *organ of smell*. Now all who can give me another organ of the body may raise hands. Annie ? . . . . . *The feet are the organs of walking*. Only of walking ? . . . . *And of running*. Anything else ? . . . . . *Of dancing*. Yes, but we will include those all under one name, MOTION, or a better word is LOCOMOTION. I will write it on the blackboard. Now all answer this word . . . . *Locomotion*. The feet are . . . . *the organs of locomotion*. Harry, repeat it. (He repeats).

I will now tell you that THAT WHICH AN ORGAN DOES is called its FUNCTION. All pronounce this word together . . . . . *Function*. We say that seeing is the function of the . . . . . *eye*, and that hearing . . . . . *is the function of the ear*. The ORGAN is that which performs the . . . . . *work*. Now who can give me other organs of the body ? Hands up. What are the organs of speech ? Thomas ? . . . . . *The organs of speech are the lips, teeth, tongue and palate*. And their function is . . . . *speech.* Mary, you may now give the first organ we named, and its function . . . . *The eye is the organ of sight, and sight is its function.* Willie, the next . . . . *The ear is the organ of hearing, and hearing is its function.* Jane, the next . . . . . *The nose is the organ of smell, and smelling is its function.* (Always require the whole statement in full.) Frank, you give the next . . . . *The feet are the organs of locomotion, and their function is locomotion.* This word simply means moving from place to . . . . . *place.* Fannie, the last one . . . . *The organs of speech are the lips, teeth, tongue and palate, and speech is their function.* Are there any others that you can think of? Dan? . . . . . *The lungs are the organs of breathing.* Raise hands all who can give me another word for "breathing." The word is RESPIRATION. All answer together . . . . *respiration;* respiration means . . . . *breathing.* Dan, will you repeat your example of an organ now, using this word? . . . . *The lungs are the organs of respiration.* Now for others. Emma? . . . . *The skin is the organ of touch.* Very well. And touch or . . . . *feeling,* is its . . . . *function.* Any others? Well, what is the organ of digestion—the organ into which the food is received? . . . . *The stomach.* Don't say STOMICK, say STOMACH; all give it again . . . . . *stomach.* Alice, you may make the statement then . . . . . *The stomach is the organ of digestion, and digestion is its function.* What are the teeth for besides speaking? . . . . . *Chewing.* Yes, but does any one know of a better word than chewing? I will write one on the blackboard. MASTICATION. Chewing is also called . . . . *mastication.* Now, Charlie, will you state about the teeth? . . . . *The teeth are the organs of mastication or chewing.* What does the tongue do besides speak? . . . . *It tastes.* Then . . . . . *the tongue is the organ of taste, and tasting is its function.* Can you think of others? Annie? . . . . . *Is the heart an organ?* Yes, the heart is an organ. It circulates the blood, or sends it through the . . . . . *body.* You may now, Annie, give us the statement about the heart . . . . *The heart is the organ which circulates the blood;* and the circulation of blood is its . . . . . *function.* You make it complete, George. (He makes it in full.)

Thus the whole body is made up, or . . . . *composed,* of . . . . *organs,* which all perform certain . . . *functions.* We will rapidly go over what we have said. The eye is . . . . *the organ of sight*, and its . . . . *function is seeing;* the ear is . . . . *the organ of hearing;* the nose is the . . . . *organ of smell;* the feet are the . . . . *organs of locomotion*, or moving from place to place; the organs of speech are . . . . . *the lips, teeth, tongue and palate.* The lungs are . . . . *the organs of respiration;* the skin is . . . . . *the organ of touch.* The stomach receives . . . . *the food*, and is called . . . . *the organ of digestion.* The teeth are also the . . . *organs of chewing*, or . . . . *mastication.*

LESSON V.

NATURAL SCIENCE—HEAT: ITS EFFECTS.

I need not say before we commence that I hope all will sit . . . . *upright*, and give their best . . . . *attention*, without which you cannot . . . . *learn.* Our lesson to-day is upon HEAT AND ITS EFFECTS.

Who can tell me what heat is? Is it anything? Would a cannon ball weigh any more if red hot than it would if cold? . . . . *No, sir.* Then is the heat that it contains anything? I see that you are not decided.

When we spoke of the atmosphere, we said that some things are only known by their . . . . *effects.* The air, for instance, we can neither see, nor . . . . *hear*, nor . . . . *feel*, nor . . . . . *taste*, nor . . . . . *smell.* Then how do we know that there is such a thing as air? . . . . *By its effects.* Now heat also produces certain effects by which it is known, besides being perceived by the sense of feeling. Raise hands all who can tell me any effect of heat. Bennie, you may tell me one . . . . *It burns us.* Well, that is the way it acts on the sense of feeling. But can any one give me any effect that it produces by which we know that a substance contains it? Let us see. Before the blacksmith places the iron rim on the wheel he . . . . *heats it.* Why? I will tell you. When the iron becomes hot, it grows much larger. I want a word which means "grows larger." George? .... *expands*. (If no one knows, tell it.) That is correct. And while it is expanded he puts it on .... *the wheel*, and then cools it. As it cools, it draws together, or ....? All listen, and I will give you the word I want. CONTRACTS. As the iron .... *cools*, it .... *contracts*, or .... *draws together*. Willie, repeat that ..... *As the iron cools, it contracts, or draws together*. Kate, you may state what we said before that .... *As the iron becomes hot, it expands or grows larger*. We now know of one effect of heat then. It causes substances to .... *expand*, or .... *grow larger*. Emma, repeat that ..... *Heat causes substances to expand*. This is the first .... *effect of heat*, that we have found.

In the next place, have any of you ever seen the stove in a dark room any other color than black?..... *Yes, sir*. You have seen it .... *red*. When does it get red? .... *When it is very hot*. And it is red or appears red because it gives out .... *light*. What causes a candle or lamp to give forth light ....? It is the same thing that makes the iron give out light and become red. That is the .... *heat*. Heat causes any substance to give forth .... *light*, when it is very strongly heated. Now I want a word which means "give forth" or "send forth." I will write it on the blackboard. EMIT. All answer together .... *emit*. If iron is made very .... *hot*, it will .... *emit light*, that is .... *send it forth*. Eddie, you may stand and repeat that. *If iron is hot enough, it will emit or send forth light*. (Do not object to having the sentence slightly changed if still correct. It shows thought and independence.)

We have now spoken of two effects of heat. 1st, ... *It causes substances to expand*, and, 2nd, ... *it causes them to give out, or emit, light*. Sam, will you repeat that? .... *The first effect of heat is, that it causes substances to expand; and the second is, that it causes them to emit light*.

Now I want you all to think of any other effect of heat. Try hard. Does it produce any other effect upon substances that you can remember? Hands up. Mary..... *It causes ice to melt*. Anything else besides ice? .... *Yes, sir; lead*. Yes, or any metal, or indeed any solid substance.

Heat changes solids into . . . . . ? What would you call water—or melted iron ? . . . . . *a liquid.* Yes, then all answer, heat changes . . . . . *solids into liquids.* But if we go further and heat the water, what then becomes of it . . . . *It is changed into steam.* That is right. And what is it that changes the liquid into a gas ? . . . . *The heat.* Very well. It changes solids into . . . . . *liquids,* and then the liquids into . . . . *gases.* Lizzie, we want to hear that statement from you . . . . *It changes solids into liquids, and liquids into gases.* What does ? Repeat again. (She repeats, using "heat" for "it.") This is the third . . . . *effect of heat.*

Now I will give you a definition for heat. HEAT IS THAT WHICH CAUSES THE SENSATION OF WARMTH. You may all repeat . . . . *Heat is that which causes the sensation of warmth.* It produces on substances three effects which we have found. 1st, ... *It causes them to expand,* 2nd, ... *It causes them to emit light,* and 3d, ... *It changes solids into liquids, and liquids into gases.* We will speak in our next lesson of its SOURCES, or whence it is derived.

LESSON VI.

NATURAL SCIENCE: ATMOSPHERIC PRESSURE.

Now all sit upright and attend. Be sure to answer promptly. Our lesson to-day is on the atmosphere.

We are surrounded upon all sides by something which we breathe, and which we commonly term the . . . . *air.* It has another name which I used just now, the . . . . *atmosphere.* This word means the air, with all that it contains, such as clouds, moisture, etc.

The shape of the earth is . . . . *round.* (See Lesson III.) Like this cent ? . . . . *No; sir; like a ball.* Round like a ball, or . . . . ? I want the word which means like a globe. Hands up. James ? . . . . *Globular.* Correct. Another ? . . . . What word means like a sphere? Annie? .... *Spherical.* Now it is because the air surrounds our sphere that it is called the .... *atmosphere.* Raise hands all who can tell me how high it extends from the earth's surface ..... ? I will tell you. IT IS FORTY-FIVE MILES HIGH. George, make that statement.... *The atmosphere is forty-five miles high.* Now we will repeat. The earth's form is .... *globular,* or .... *spherical,* and it is surrounded by a fluid called the ..... *atmosphere,* which is how high? .... *forty-five miles.* Now we will go a step further. Boys sometimes in their play "pile on" one another. Who sustains the greatest pressure? .... *The boy underneath.* And if this room was piled full of shot, the lowest layer would sustain the weight of .... *all the rest,* the next layer not quite so .... *much,* and so on to the top. Just so it is with the .... *air,* or ..... *atmosphere.* The lowest layer bears the .... *weight,* of all that lies .... *above it.* Hence it sustains the greatest .... *pressure.* Who can tell me the amount of pressure of the atmosphere? I will tell you. If you measure on the ground a space of a square inch, and suppose a column of air to rest upon it, extending to the top of the air, that is how high? ..... *forty-five miles,* this column of air would weigh fifteen pounds. Hence, we say that the air presses with a force of FIFTEEN POUNDS ON EVERY SQUARE INCH. Ella, you may repeat that. (She repeats. Call on others.) Then on two square inches it would exert a pressure of.... *thirty pounds,* and on four square inches .... *sixty pounds.* Then why do I not feel a great weight upon my hand, which is more than four square inches? (In order to explain this, take a common glass tumbler and fill it brimful of water, place a piece of paper over the surface of the water that will completely cover it. Then take the tumbler in the left hand, place the palm of the right hand upon the paper on the surface, so as to keep it in position, and invert the tumbler. Hold it with the left hand, and take the right away from the paper. The water will not flow out. It will be supported by the upward pressure of the air.) Who can tell why this water does not flow out? Willie? .... *I suppose it is because the air presses up against it and keeps it in.* That is very well explained. It is kept in by the ..... *pressure*, of the ..... *air*. Now who will answer my former question? Why cannot I feel the weight upon my hand? Alice? .... *The air presses upwards underneath it, just as forcibly as it presses downwards above it.* Good, and we stated just now that its pressure amounts to how much? Lizzie? ..... *Fifteen pounds on every square inch.* Make a complete statement. (She makes it.)

On account of this pressure the particles at the lower part of the atmosphere are pressed tightly together. Now if we were to place a layer of hops over the floor of this room, and then put two more layers over them, the lower layer would be a very little pressed .... *together*. But if we filled this room with ..... *hops*, the lowest .... *layer*, would sustain so much .... *pressure*, that they would be very much .... *squeezed.* I want a better word. I will tell you one. COMPRESSED. All answer ..... *compressed.* If you take a sponge and close your hands upon it, it becomes ..... *compressed.* Repeat that, Charlie. (He repeats, or if he cannot, through inattention, cause him to write it on his slate three or four times after calling on some one who can. If he still pretends he cannot, keep him in at recess, and allow some smaller boy to dictate the words to him slowly, then let him have remainder of recess.) And just so with the air. The particles down at the earth's ..... *surface*, on account of the ..... *weight above them*, are very much ..... *compressed*, and the air there is said to be very ..... *thick.* (This, or some other word, will probably be given.) I want a better word ..... *pressed.* Better yet. Can you not think of a word that means very much compressed? A dark heavy cloud would be said to be .... ? I will give you the word I wanted, if all are very attentive. It is DENSE. All repeat it .... *dense.* Together, again .... *dense.* Air at the earth's surface is said to be very ..... *dense.* Now what is the opposite of dense? Any one? I will tell you. It is RARE. All give it ..... *rare.* Then away up in the upper regions of the .... *atmosphere*, the air is very .... *rare*, because, George? .... *there is not so much pressure upon it.* Charlie, repeat that. (He repeats.)

Now, all answer rapidly. The form of the earth is .... *round like a ball*, or .... *globular*, or ..... *spherical*, (same order in which taken at first,) and it is surrounded on all .... *sides*, by a thin fluid called the .... *atmosphere*, which extends to the height of .... *forty-five miles*, above its .... *surface*. Since the air in the lower parts of the .... *atmosphere*, has to sustain the ..... *weight*, of all that lies .... *above it*, it is greatly ..... *compressed*. Hence the lower portions are very .... *dense*, while the upper parts are .... *rare*. The pressure, which means the force with which it ..... *presses*, is about ..... *fifteen pounds on every square inch*. The reason we do not perceive this immense ..... *pressure*, is that the particles press ..... *upwards* (gesture here) as well as .... *downwards*. We prove this by means of that glass of .... *water*, which did not .... *spill*, although we turned it .... *upside down*, or .... *inverted it*.

LESSON VII.

ASTRONOMY: MOTIONS OF THE EARTH.

This morning we are to have a lesson on the motions of the earth. All must be very .... *attentive*, and in order to be so, it is necessary to sit .... *erect*.

Of what shape is the earth? .... *Round like a ball*, or .... *globular*, or .... *spherical*. When we spoke of its form (See Lesson III.) I did not tell you what it rested on. Does it rest on anything? Have you ever seen a boy with a string and a button, or a ball tied on the end of it? ..... *Yes, sir*. Well, what does the button rest on, if the boy swings it round his head? .... *Nothing*. And still it does not fall to the .... *ground*. Well, the earth is suspended in space in very much the same ..... *way*. But, instead of a string, or anything of the kind, there is a very strong force called ATTRACTION which draws it towards the sun just as the string draws the ..... *button*, towards .... *the boy's hand*. If the string breaks, the button ..... *flies off*, but if not, it holds .... *the button*, in its ..... *place*. Let us invert this sentence. The earth is held in its . . . . *place*, by . . . . . *attraction*. It is attracted toward the . . . . . *sun*. Now, why does it not go right into the midst of the sun? I will tell you. Like the button, it goes round the sun, which tends to keep it . . . . . *off*, just as the motion of the button keeps it away from the . . . . *hand*. (It is best to have a contrivance of this kind at the time of giving the lesson to illustrate it.) I have just said that the earth goes round . . . . *the sun*. Bessie, repeat that. . . . *The earth goes round the sun*. Can any one give me a word instead of "goes?" (If not, write it.) Well, Sam? . . . . . *Swings*. You try, George . . . . . *Revolves*. That is the word. The earth . . . . . *revolves*, round the sun. Lettie, repeat that. (She repeats.) In the next place, how long does it take to revolve once completely round the sun? Henry? . . . . . *One year*. That is correct. All may answer . . . . *One year*. Fred, repeat that. . . . *The earth revolves round the sun in one year*. This is called the REVOLUTIONARY MOTION of the earth. I will write this on the board. Let me hear these two words from all. . . . *Revolutionary motion*. The earth's motion round the sun is called its . . . . *revolutionary motion*. Fannie, repeat that. (She repeats.)

But are we not altogether mistaken? It appears to me that the sun rather revolves round the earth! You have all seen the sun rise in the . . . . *east*, and set in the . . . . *west*. How is this? When on a railroad train we can imagine that the trees, houses, telegraph poles, and fences are all moving in the opposite . . . . . *direction*, to that in which we are . . . . *going*. But are they? . . . . *No, sir*. No, they only APPEAR to do so. Their backward motion is only . . . . *apparent*. (Write this word if they fail to answer it.) And you will afterwards find that it is on account of another motion of the earth that the sun APPEARS to revolve around it.

What is the other motion? If a wagon moves down the street, its wheels move along the ground just as the runners of a sleigh would. But they also have another motion. What is it? . . . . *They move round the axles*. Right; and as the earth revolves round . . . . *the sun*, it also turns or spins round like a . . . . . *wheel*. This is its second motion. Can any one tell me how often it turns round in this way? George? . . . . *Once in twenty-four hours.* Very good. (Tell it, if not known.) And what is this motion called? I will show you. The Latin word ROTA means a wheel, and to ROTATE is to turn round like a . . . . *wheel;* therefore, this is called its ROTATORY motion. (Primary accent on first syllable. Secondary on the third. Write these words and all NEW WORDS.) Now, a wheel rotates on the . . . . . *axle*, and the earth . . . . . *rotates*, on its AXIS. Repeat that, Jennie. (She repeats.) Do you think the earth's axis is anything like the axle of a wheel? . . . . *No, sir.* When a top spins, it does not spin on an axle, but on an axis. An axis is only imaginary, that is, it does not really exist like an axle.

Now, you may answer rapidly. The earth has two . . . . *motions.* One is called its . . . . . *revolutionary motion*, and is performed round . . . . *the sun*, and the other is its . . . . *rotatory motion*, which is performed round an imaginary line called . . . . *the axis*, which corresponds to the . . . . *axle of a wheel.* It performs one revolution in . . . . *a year*, and one rotation in . . . . . *twenty-four hours.* We will see in another lesson that this last motion causes day and night and other curious phenomena. All prepare for our next work.

LESSON VIII.

PHYSIOLOGY: THE FIVE SENSES.

We now expect all to sit upright and keep their senses about them. In order to answer promptly, you must give your best . . . . *attention.* Again, I want your best . . . . . *attention.*

When we are asleep we cannot tell anything that is going on around us. Rapturous music may be in the air, but we cannot . . . . *hear it.* Beautiful pictures may hang all around, but we . . . . *cannot see them.* Our bed-clothes are around us, but we cannot ..... *feel them.* Unpleasant odors may fill the room, but we ..... *cannot smell them.* Neither can we taste anything. Nothing can come into the mind from outside. Are there any other ways by which we know what is around us besides what we have mentioned? ..... *No, sir.* How many ways did we name? ..... *Five.* Now, these five ways by which knowledge passes into the mind are called ....? They are called THE FIVE SENSES. All repeat ..... *the five senses.*

The first sense that we will speak of is the most important; it is the sense of .... *seeing.* (Use gestures, such as pointing to the eyes.) You remember our lesson upon "organs and ..... *functions.*" The organ is ..... *that which acts.* The function is ..... *that which the organ performs.* Well, raise hands all who can tell me the organ of sight. Willie? ..... *The eye is the organ of sight.* Now who can tell me the function of this organ? Annie? .... *The function of the eye is seeing, or sight.* Is there anything else required for sight besides the eyes? Suppose we are shut in a dark room, can we see? .... *No, sir.* Why? .... *There is no light.* Then we see by means of .... *the light.* The light enters our .... *eyes,* and produces in the mind a picture of the object that we look at. This picture is called a ....? Anything that is calculated, you would call a .... *calculation.* And anything that is formed a .... *formation.*. Then what would anything be called that passes in through one of the senses? ..... *A sensation.* (Never tell a word if there is any way of making the scholar think it out for himself.) Correct. The mind receives sensations through the ..... *senses.* Anything that is seen, then, causes a .... *sensation.*

The next sense that we will refer to is .... *hearing.* (Pointing to the ear.) The organ that performs this office is .... *the ear,* and the act of hearing is .... *the function of the ear.* Lizzie, will you make a short statement of this fact? ... *The ear is the organ, and hearing is the function that it performs.* By what means do we hear? I will tell you. It is by the air. At some other time we will have a lesson on each sense, and then I will explain how we hear.

But you may all answer for the present that it is by means of . . . . *the air that we hear.*

We have now mentioned two senses. They are . . . . . *Seeing and hearing.* The organ of sight is . . . . . *the eye,* and we see by means of the . . . . . *light.* Harry, repeat. (He repeats.) The organ of hearing is . . . . *the ear,* and hearing is called its . . . . *function.* We will now pass on to the next sense, feeling. Let me hear this from all . . . . *feeling.* It is sometimes called touch. The sense of . . . . *touch,* or . . . . *feeling.* Raise hands those who know what is the organ of touch. James? . . . . . *The skin.* Yes, and its . . . . . *function,* is . . . . . *feeling.* If I move backwards against the wall, with my hands extended behind me, how do I know when I have arrived at the wall? . . . . *By feeling it.* When my hand touches it, a kind of influence is excited there which passes to my . . . . . *mind.* This influence you would call a . . . . . ? Since it passes in through the sense of feeling it is a . . . . *sensation.* And sensations pass along the . . . . ? Can no one tell me the name of those organs whose function it is to carry sensations to the mind? If you will all remember, I will tell you. They are called NERVES. Let me hear all answer this word together . . . . . *nerves.* The influence excited on my . . . . . *hand,* passes along the . . . . *nerves,* to the . . . . *mind,* where it produces what we call a . . . . . *sensation.* Can any one tell me where the sense of feeling is most acute? I will tell you. It is most acute in the hands, and especially at the finger-ends. The fine nerves which are found at the ends of . . . . *the finger,* are protected by the . . . . *finger-nails,* because they are so delicate. The organ of touch, then, is . . . . *the skin,* and its . . . . *function,* is . . . . *feeling.* The sensations produced upon the skin pass along . . . . *the nerves,* to the . . . . *mind.* Give the last sentence again, Charlie . . . . *The sensations pass along the nerves to the mind.* Good.

We now come to the sense of SMELL. Even if we were deprived of eyes, ears, and feeling, if there were burning brimstone in this room we would soon know it by . . . . . *the sense of smell.* And we could also tell that sugar was . . . . *sweet,* and vinegar . . . . *sour,* by the remaining sense of . . . . *taste.*

We have said that the mind knows things by the five .... *senses.* I want a better word than "knows." I will give you it. This word is always used in the sense of which we are now speaking. It is PERCEIVES. The mind .... *perceives*, or .... *knows things*, by the .... *five senses.* The 1st of these is .... *seeing*, in which the eye is the .... *organ*, and ..... *sight the function.* 2d, ... *Hearing*, in which ..... *the ear is the organ*, and ..... *hearing is the function.* 3d, ... *Feeling*, or ..... *touch*, in which ..... *the skin is the organ and feeling the function.* 4th, ... *Smell*, where the ..... *nose is the organ.* 5th, ... *Taste*, of which the organ is .... *the tongue.* Through these five .... *senses*, the mind receives .... *sensations.* The sensations travel along .... *the nerves*, to .... *the mind*, which is said to know them or ..... *perceive them.* That is the best word, and the one I wish you always to use. You say that the mind .... *perceives sensations.*

* * *

LESSON IX.

NATURAL SCIENCE: ATMOSPHERIC PRESSURE.

To attend, you have often told me, means ..... *to look and listen.* Without doing this you could not .... *answer.*

In our former lesson on THE ATMOSPHERE (See Lesson VII.) we stated the fact that the earth was surrounded by a thin .... *fluid*, called ..... *air*; and that this air, with all that it contains, such as ..... *clouds*, and ..... *smoke*, and .... *moisture*, receives the general name of ..... *the atmosphere.* The atmosphere you also told me extends to the height of .... *forty-five miles*, and exerts on the earth's ..... *surface*, a pressure of ..... *fifteen pounds on every square inch.*

Now do you believe all this? How do we know that there is any such thing as air? For instance, there is air in this .... *room*, but I can neither SEE it, nor .... *hear it*, nor can I . . . . *feel it*, or . . . . *taste it*, or . . . . *smell it*. How then do I know that it is here at all? In speaking of the FIVE SENSES (See Lesson VIII.) we said that there are five ways in which we become . . . . . *acquainted with the things that surround us*. Mary, repeat that sentence. (She repeats.) And now we find that we cannot tell that there is air in this . . . . *room*, by either of these five . . . . *senses*. Well, Sam, I see your hand up. What is it? . . . . . *I can feel the air when I do this* (striking his hand rapidly through the air). Good. I see that we have one boy who THINKS some. But, Sam, when I said we could not feel it, I meant by rubbing our hands together, or the finger and thumb simply, just as you would feel flour or sand. We will repeat our statement; at the same time we are much obliged to you, Sam, for your suggestion. We cannot tell, in the ordinary way, that there is air in . . . . *this room*, by any of the five . . . . *senses*. The question is, then, how are we to tell?

Now, I am going to tell you that SOME THINGS ARE ONLY KNOWN BY THEIR EFFECTS. I have written this on the blackboard. I will now try how many boys or girls there are here who notice things that happen around them; or, observe things that come within their observation. Who can give me an example to illustrate what I have written on the blackboard? George? . . . . . *If a stranger in a city passed by a cellar full of ashes and cinders, he would know that a house had probably been burnt*. That is an excellent . . . . . *example*. Are there any others that any one thinks of? Kate? . . . . . *When we see a field of wheat, we know that wheat has been sown there*. Very good. We would know that the farmer had sown his . . . . . *wheat*, although we did not perceive it through any of our . . . . *senses*. We would, in that case, know it by . . . . *its effects*. We see the effect, and then judge of the cause. This is called judging of things, or knowing things by . . . . *their effects*.

We will now apply this to our subject. If we see the leaves of a tree all in motion, we then immediately think that there must be something that makes them . . . . *move*. They have no power in themselves to . . . . *move*, and must therefore be moved by . . . . . *something else*. That something which moves them is . . . . . *the air*, and thus we conclude that there is such a thing as . . . . *air*, from its . . . . . *effects*. I want to hear that word from all . . . . *effects*. And if we see a door slammed to with a great . . . . *noise*, and no one near it, since the door itself cannot . . . . . *move*, some force must have . . . . . *shut it*, and we conclude that it was closed by the force of . . . . *the air*.

And when we performed that experiment with the glass of . . . . *water*, which we will now repeat, or perform . . . . *again*, we found another . . . . . *effect of the air*. By its pressure, as we judge, it causes the water to remain in . . . . *the glass*. Now I will extend this lesson a little further. If this tumbler were twelve inches high, instead of four, do you think that the air would still keep it full of water, if inverted so? . . . . *Yes, sir*. If it were ten feet long, or were a long tube closed at one . . . . . *end*, do you think it could then keep it full? I see you cannot tell. It would. And it would do so if the tube were THIRTY-TWO FEET LONG. What did I say then, Willie? . . . . *You stated that the pressure of the air would keep an inverted tube, thirty-two feet long, full of water*. But if it were longer than that, it would not remain full. Or we will state it thus: THE PRESSURE OF THE ATMOSPHERE WOULD SUPPORT A COLUMN OF WATER THIRTY-TWO FEET HIGH. Charlie, repeat that. (He repeats.) You may all write this on your slates, as I have done on the blackboard.

LESSON X.

NATURAL SCIENCE: THE THREE FORMS OF MATTER.

Now I wish you all to give your attention to what I have to say. In order to improve, every one must . . . . *attend*.

There is one word that is used to represent all the different things that exist in nature. When we use this word we may mean clay, iron, water, rock, air, grass or any other thing that we can . . . . *think of*, or . . . . *find*. Can any one tell me what word this is? All try and think of it. I want to see some hand raised. Kate, I see your hand up; what do you think it is? . . . . *Things*. Well, that word would do in most cases. But could you say elegantly that a lot of wheat, for example, is a thing? Would you say, "what a large thing that wheat is," for instance? . . . . . *No, sir*. Who can think of a better word? You see that I wish you all to think hard before I tell you. Since no one knows, I will give you the word. All the substances that I have named, you may repeat them . . . . . *clay*, *iron*, *water*, *rock*, *air*, and . . . . . *grass*, may be called MATTER. We will put this word on the blackboard. I said that they could all be called different kinds of . . . . . *matter*. This word may mean anything that we can find in the . . . . *world*, or in any other . . . . . *world*. We can call it all . . . . . *matter*. I am going to try how long every one will remember this word. All may repeat it again . . . . . *matter*. Willie, what about matter? . . . . *It is a name that is used for everything around us*. Would you call this ink matter? . . . . . *Yes, sir;* and sand or coal would also be . . . . . *matter*.

Now the earth is composed or . . . . *made up*, of many different kinds of . . . . . *matter*. And this matter we find in various forms. How many forms does it assume? Perhaps this will be a very difficult question for you to answer, so we will leave it unanswered till the end of the lesson. But I want you all to keep an accurate account as we go on. All substances like wood, coal, or limestone we call . . . . . ? They will not pour like water, because they are . . . . *solid*. That is the word. All repeat . . . . *solid*. Raise hands all who can give me other solids. John? . . . . *Brass*. Mary? . . . . *Iron*. Willie? . . . . *Paper*. Fred? . . . . *Clay*. George? . . . . . *Ice*. Well, that will do. Ice and iron are both . . . . . *solids*. They are solid forms of . . . . . *matter*. Anna, repeat that . . . . . *Ice and iron are solid forms of matter*.

I wish you to tell me now how we could change their form. Do you remember what we said (See Lesson v.) when speaking of the effects of heat? . . . . . *Yes, sir; it changes solids into liquids*. That is correct. How, then, could we change the form of ice and iron? . . . . *By heating it.* And the heat causes it to . . . . . *melt*, or become . . . . *liquid.* This is the second form of . . . . . *matter.* Some kinds of matter are . . . . . *solid*, like . . . . . *iron or ice*, and other kinds are . . . . . *liquid*, like . . . . . *water.* Who can mention other liquids? Sam? . . . . *Oil.* Kate? . . . . *Milk.* Mary? . . . . *Medicine.* Yes, some kinds of medicine are. George? . . . . *Blood.* Very good. That will be sufficient now. These substances last named are . . . . *liquids.* What is a liquid? Frank? . . . . *Anything like water.* Anything that flows like . . . . . *water*, is a . . . . . *liquid.* When we heat ice it . . . . *melts*, or . . . . . *becomes liquid*, and forms . . . . *water.*

Now, we wish to still further change the form of this substance, how shall we do it? . . . . . *By heating it.* Yes, this would change it into another . . . . . *form.* It would then be . . . . *steam*, or . . . . *vapor.* What do we call this form? I will write it. GASEOUS. It is so called because it is like a . . . . *gas*; gaseous means . . . . *like a gas.* The air that we breathe is a . . . . *gas.* What kind of substance would you call air, then? . . . . *gaseous.* And when a liquid is heated, its condition is called . . . . . *gaseous.* Ice, then, is a . . . . *solid*, water . . . . *a liquid*, and steam . . . . *a gas.* Libbie, repeat that sentence. . . . . *Ice is a solid, water a liquid, and steam a gas.*

When water becomes vapor, it is said to . . . . . ? We will take this way of finding out. In map-drawing, when you form a continent by using a triangle as a basis, you are said to . . . . *triangulate it.* Then, can you think of the word I want? You have all heard it. When water turns into vapor, it . . . . . *evaporates.* Only one boy answered then. Let me hear it from all . . . . . *evaporates.* And the process is called . . . . . *evaporation.* (If they do not know the word triangulate, take any similar word that they do know, to illustrate. The word evaporate may be given at once.) George, repeat that . . . . . *When water becomes vapor it evaporates, and the process is called evaporation.* Water is caused to evaporate by . . . . *heat.*

Next, we will revise what we have said. Every substance may be included under one name. That is . . . . . *matter.*

Matter exists in different .... *forms.* We have found.... *three forms.* 1st, ... *the solid form.* 2d, ... *the liquid form,* and 3d, ... *the gaseous form.* These are called the three forms of matter. How many can now state the forms of matter? Harry? ..... *Matter is found in three forms, solid, liquid and gaseous.* Sarah, you may also state it, and use the word EXISTS instead of "is found." (She repeats.)

Now, if we wished to change vapor back into water, what would you naturally think we would have to do? When we changed water to ..... *vapor,* we applied ..... *heat,* and if we are to change the vapor back to .... *water,* we must ..... *take away the heat.* Give me a word that means "take away." Hands up. Well, I will write one. DEPRIVE. We would have to ..... *deprive the water of heat,* to change it back again to vapor. Has any boy or girl ever held a cold plate or spoon in the spout of a tea-kettle where the vapor was issuing? Sam? .... *I have.* And when the cold plate takes the ..... *heat,* out of the ..... *vapor,* it changes back into ..... *water,* and stands upon the plate in small ..... *drops.* Do you know what this process is called? It is called CONDENSATION. The vapor is said to CONDENSE. All may answer. It is said to .... *condense.* And when vapor .... *condenses,* it forms .... *water.* If we now make the water very cold, that is, deprive it of its .... *heat,* it, in turn, becomes .... *ice,* and is said to .... *freeze.* There is a better word. CONGEAL. The water ..... *congeals.* By cooling, then, vapor would .... *condense,* and form .... *water,* and water would .... *congeal,* and .... *form ice.* (Then rapidly review. Invert sentences when you can.)

LESSON XI.

CHEMISTRY: COMPOSITION OF THE AIR.

The atmosphere, you have several times told me, (See Lesson VII.) surrounds our .... *earth,* to the height of ....

forty-five miles; it also exerts a pressure upon the earth's . . . . . *surface*, of . . . . . *fifteen pounds on every square inch.* In the upper . . . . *regions*, of the . . . . . *atmosphere*, the air is quite . . . . *rare*, but at the earth's . . . . *surface*, it is very . . . . . *dense.* I am glad you remember these facts so well. Now, what kind of properties would you call these? Its pressure, density and . . . . . *rarity*, are what kind of qualities or properties? Listen attentively, while I tell you. I will write the word on the blackboard. They are MECHANICAL properties. We are now to have a lesson on some other properties of the air; or rather, we will speak of its composition, by which I mean the things of which it is . . . . *composed*, and also some of their properties.

You have all told me that that which we breathe is . . . . *air.* Now, can any one in the school tell me whether it is only one kind of air or several kinds? Kate? . . . . *Several kinds.* How do you know that? What are they? Now it will not do to answer anything without being able to give a reason for it. In all your answers, try and be accurate. When you are uncertain, do not be too hasty. Her answer was correct, however. There are more kinds of air than one in the . . . . *atmosphere.* What are their names? Perhaps you have never thought of this before.

Is a cup of tea only one kind of liquid? . . . *No, sir.* It has at least two liquids mixed, water and . . . . *milk.* Well, the air has two principal kinds of gas or air in it. I used a new word then. What was it? . . . . *Gas.* Yes, this also means . . . . . *air.* The most important kind of gas in the air—we will use the word GAS now for one single kind of air—is called OXYGEN. Let me hear this word from all . . . . *oxygen.* What about oxygen, Charlie? . . . . *Oxygen is the most important gas in the air.* It is the oxygen that is used up when we breathe the . . . . . *air*, into our . . . . . *lungs.* And it is the oxygen that causes a fire to . . . . . *burn.* The other gases in the air would not support a flame at all by themselves. They would not do to breathe. Then why not have the air all oxygen? George? . . . . *It might be too strong.* Well, that is the very reason I wanted. All may repeat. The air would be . . . . . *too strong*, if it was pure . . . . . *oxygen.* I hope you never go into saloons or places where liquor is sold, but you may have seen people drink strong liquor. Do they drink it just as strong as it is when they buy it? . . . . *No, sir; they put water in it first.* They do this so as to make it not quite so . . . . . *strong*, or to . . . . *weaken it.* Can you not give me a better word than "weaken?" Look at the blackboard while I write one. DILUTE. What is it? . . . . *Dilute.* They put the water into the . . . . . *liquor*, to . . . . . *dilute it.* And the Creator has very wisely diluted the gas that we spoke of in the . . . . *air*, the . . . . . *oxygen.* It is . . . . . *diluted*, with another gas called NITROGEN. Repeat that, Sam? . . . . . *The oxygen is diluted with another gas called nitrogen.* Which of these two gases is the most important? Hands up. Sarah? . . . . *The oxygen is the most important.*

Can any one tell me, now, how much oxygen there is in the air, in proportion to the nitrogen? How much oxygen would there be in ten bushels of air? If you will all remember it, I will tell you. THERE WOULD BE TWO BUSHELS OF OXYGEN IN TEN OF AIR. Then how many in five bushels of air? Peter? . . . . . *There would be one bushel of oxygen in five bushels of air.* And if we should take a large room full of air and divide it up into five parts, one part would be . . . . *oxygen*, and the other four parts . . . . *nitrogen*, to dilute one part . . . . *of oxygen.* Mark, repeat that. (He repeats.) But do you think that the oxygen would all be by itself, and the nitrogen also by itself? . . . . *No, sir.* No, they are thoroughly mixed . . . . *together.* If I were to put one quart of gunpowder and four quarts of onion seed into a box, and shake them up together, this mixture would represent the . . . . *air.* The gunpowder would represent the . . . . . *oxygen*, and the onion seed . . . . . *the nitrogen.* How many quarts of mixture would I have? . . . . *Five quarts.* Hence we say that one-fifth of the air is . . . . . *oxygen*, and four-fifths . . . . *nitrogen.* Who will state this? George? . . . . *One-fifth of the air is oxygen, and four-fifths nitrogen.*

Now review rapidly. The air does not consist of only one kind of . . . . . *gas*, but . . . . *several kinds.* It consists almost entirely of . . . . *two kinds of gas.* They are 1st, ... *oxygen*, which is the most . . . . . *important*, and 2d, ...

nitrogen, with which the oxygen is . . . . . *diluted*, or . . . . . *weakened.* For one barrel of oxygen, there are . . . . *four barrels of nitrogen.* Or better, for one PART of oxygen there are . . . . *four parts*, of nitrogen, to make up . . . . *five parts*, of . . . . *atmospheric air.*

LESSON XII.

MENTAL SCIENCE: MEMORY.

Now, I want your best attention. We are to have a lesson this morning on MEMORY. We will also speak of its improvement.

What is memory? You have heard people say, "I have such a poor memory." What do they mean? Lizzie? . . . . *Remembrance.* James? . . . . *Recollection.* Well, let us see. If a man told you he could remember all about the battle of Winchester because he had passed through it, but could not remember anything of the other battles of the Rebellion, would you say that he had a good memory? . . . . *No, sir.* But he would have a good recollection of that particular battle. His remembrance of that . . . . *battle*, might be very . . . . . *good*, and yet he would have a poor . . . . . *memory.* Then there is a difference between remembrance, or recollection, and . . . . . *memory.* I would like you to listen to me while I tell you what memory is. I am writing the definition on the blackboard. You have all tried hard to think of it, but as you cannot, I will give it. MEMORY IS THAT FACULTY OF THE MIND BY WHICH WE RECALL PAST OCCURRENCES. Annie, repeat that . . . . . *Past occurrences.* I thought so. This girl was looking out of the window at something, and so, although the sound entered her . . . . . *ears*, it must have gone in at one ear and . . . . . *out at the other.* (Make gestures with the hands to indicate your meaning.) Annie, do you not feel ashamed to see so many hands up all around you? You will remain in at recess, and write that definition five times upon your slate. If you cannot do it alone, then I will get little Willie, here, to dictate it to you. Willie, you may give it . . . .*Memory is that faculty of the mind by which we recall past occurrences.* I said that it was a . . . . . *faculty*, of the . . . . . *mind.* This means a POWER of the mind; or, more simply, a PART of the mind. Memory, then, is that . . . . . *faculty*, or . . . . . *power*, or . . . . *part*, of . . . . . *the mind*, by which we . . . . . *recall past scenes.* (Ask several to repeat this.)

Memory is a very important faculty of the mind. Think what we would be without memory. I might show you how to perform an operation in arithmetic, or to analyse a sentence, but if you could remember nothing of it next day, would it be of any use? . . . . *No, sir.* Memory, then, is very . . . . *important*; and it must be a valuable thing to know how to preserve or improve it. I will tell you some ways to do this.

The first thing to be attended to is this: We must always UNDERSTAND what we wish to . . . . . *remember.* Charlie, repeat this. (He repeats.) If you do not understand a question in arithmetic, can you remember it? . . . . *No, sir.* You cannot . . . . *remember it*, till you . . . . *understand it.* We must first . . . . *understand*, and then . . . . . *remember.* Kate, repeat the first statement respecting the cultivation of memory . . . . *We must first understand what we wish to remember.* Unless we understand a thing it is impossible . . . . *to remember it.*

What else do you consider necessary in cultivating memory? I will tell you another thing. Children often attend a concert in which they feel highly INTERESTED, and therefore remember all about it. The same children may listen to a lecture or discourse, in which they are not at all . . . . *interested*, and then they do not . . . . *remember it.* George, try whether you can state this then . . . . *We must also be interested in what we wish to remember.* If a scholar is not interested in the lesson—if he would just as willingly play with his fingers, or look out of the . . . . *window*, it is impossible for him . . . . *to remember the lesson.* The first point we noted was, that we must . . . . *understand what we wish to remember*; and the second, we must be . . . . *interested in what we wish to remember.*

The third way is to use MAPS, CHARTS, DIAGRAMS, BOOKS, PICTURES, EXPERIMENTS, or any other AIDS that can be procured. What is the third method? Ella? . . . . *It is the use of such aids and illustrations as maps, charts, diagrams, books, pictures, experiments, etc.* When we study geography, for example, we cannot do so well by committing to our memory a long list of names, as we could if they were accompanied by a map to show their . . . . *position.* The map would aid our . . . . *memory.* And so in the study of chemistry, in our lesson on ATMOSPHERIC PRESSURE you could not have remembered it half so well if we had not performed that . . . . *experiment,* to illustrate our subject. The experiment, you see, gave great assistance to our . . . . *memory.*

Now there is still one more way to aid the memory. It is what we call THE LAW OF ASSOCIATION. When I tell you about Mount Vernon, if I also tell you that Washington was born there, this will furnish great assistance in trying to . . . . *remember it.* If you remember this place . . . . *Mount Vernon,* you will then, by this law of . . . . *association,* associate with it the name of . . . . *Washington,* and thus you will remember it when you remember . . . . *Mount Vernon.* And when you think of Washington, you will think of the place where he . . . . *lived.* This method of associating one fact with . . . . *another,* is called the . . . . *law of association.* This is the fourth method of aiding the . . . . *memory.*

Now, we will recapitulate. Memory is that . . . . *faculty,* of the . . . . *mind,* by which we . . . . *recall past scenes.* It can be cultivated in four . . . . *ways.* 1st, ... *By always understanding what we wish to remember.* 2d, ... *By feeling interested in what we try to remember.* 3d, ... *By using such aids as maps, charts, books, experiments, diagrams, etc.* And 4th . . . . *By the law of association.*

LESSON XIII.

ETYMOLOGY—DERIVATION: WORDS FROM TRAHO.

As every one is in perfect order, we will proceed at once with our . . . . *lesson.* To-day we are to have a lesson on the derivation of words, or the manner in which they are .... *derived*, or .... *obtained.* I know you will all be very much interested in this lesson.

All observe what I write on the board. (Write on the blackboard as follows:) TRAHO; TRACTUM; *to draw.* This is a word from the Latin language. A great many words in the English language are derived from .... *Latin.* The last two letters of the second word are called the ending of the word. Do any of you know a better word than "ending?" What is the ending of a railroad called? .... *The terminus.* Yes, and the ending of a word is called its TERMINATION. The termination of tractum is .... *um.* Do you know what the other part of the word is called? I will tell you. TRACT is called the ROOT of the word. Willie, I wish you to tell me the two parts of this Latin word .... *The root is tract, and the termination is um.* Very good.

Now the part that I called the root, which is .... *tract,* and means .... *to draw,* is found in a great many English words. Raise hands all who can think of any word with "tract" in it. Bessie? .... *Attract.* That is an excellent example. What two letters, Bessie, did you place before "tract?" .... *At.* Now this part of the word ATTRACT is called the PREFIX. "At," again, is called the .... *prefix.* PRE itself is a prefix. It means "before," and "prefix," is so called because it is "fixed before" another word. In attract, then, AT is the .... *prefix.* I will tell you that its proper form is AD, not AT. But on account of the unpleasant sound of the word "ADTRACT" it is preferred to call it .... *attract,* thus changing the *d* to .... *t.* The prefix AD, means TO; and tract, you say, means .... *to draw.* Then what will attract mean? .... *To draw to.* That is correct. A magnet will .... *attract,* pieces of .... *iron,* such as .... *needles,* or .... *pens, etc.;* that is, it will .... *draw them to it.* Who will now form another word by adding another syllable to attract? George? .... *Attraction.* That is the word. It means the act of .... *attracting,* or .... *drawing to.* Now add IVE instead of ION. All may give it .... *Attractive;* this means having the power of .... *drawing to,* or .... *attracting.* There are also others, but we will pass on.

Can any one give me another word with "tract" in it? That's right, I see every hand up. Kate? .... *Contract.* Very well. What prefix did she use? Fannie? .... *Con.* This means TOGETHER. (Keep these prefixes written on the blackboard, under each other, with the meanings opposite.) What will contract mean? Sam? .... *To draw together.* When red-hot iron cools, it .... *contracts.* Or if you stretch a piece of India-rubber, it will afterwards .... *contract,* or .... *draw together.* When two men are drawn together by a written agreement, this agreement is called a .... *contract,* because it binds or .... *draws them together.* One of these men who contracts with the other would be called a .... *contractor.* This is another word. Any other? .... *Contraction.* Yes. We will now pass on, and take other words.

Raise hands for others. Lizzie? .... *Retract.* Well, let us analyze this word. RE means BACK, and tract, we have said means .... *to draw.* Then retract will mean .... *to draw back.* Would you call it retracting this chair, if I draw it back? I must state that this word is not used for objects such as this .... *chair,* but it is used in connection with our statements. When a false statement is made, it is sometimes contradicted by the person who made it. He is said to take his words back or .... *retract them.* We retract .... *statements,* but not .... *objects.*

Now raise hands all who know other words from tractum. Jane? .... *Distract.* The prefix of this word is .... *Dis.* DIS means APART or ASUNDER. What, then, does distract mean? Charlie? .... *To draw apart.* That is correct. But here I have a piece of paper in my hands. If I draw the paper apart will that be distracting it? Let me tell you that it would not. It is only used in connection with the mind. When our minds are, so to speak, drawn apart by care, they are said to be .... *distracted.* Trouble and annoyance would ..... *distract the mind.* Loud talking or whispering in the school-room would draw the attention apart or ..... *distract it.* Anything that interrupts us .... *distracts the attention.*

I now wish to hear other words. Hands up. George? ..... *Subtract.* Now we have a good word. The prefix SUB means UNDER. Consequently the word .... *subtract,* will mean .... *to draw under.* Why do you think it is to draw under, any more than to draw over, George? ..... *Because the number that is subtracted is written under the other.* Yes, I suppose that is the reason.

Fred, what is your word? ..... *Protract.* The prefix of this word is ..... *Pro.* It means FORWARD. Then to protract is ..... *to draw forward.* When our lesson has been drawn ..... *forward*, we say it has been ..... *protracted.* Protracted meetings are meetings that are .... *drawn forward*, or, a great many of which are held in a short .... *time.* By a protracted discourse we would mean a very .... *long one.*

Allie? Your word? .... *Detract.* This is another good word. DE, which is the ..... *prefix*, means DOWN. And detract will mean ..... *to draw down.* Could I say "I will detract this ceiling?" Let me tell you that this word is applied to character. When one person slanders another, or draws down his .... *character*, he is said to .... *detract his character.*

The root of these words is ..... *tract.* The first word was .... *Attract*, which means ..... *to draw to;* 2d, ... *Contract*, to .... *draw together;* 3d, ... *Retract*, to .... *draw back;* 4th, ... *Distract*, to .... *draw apart;* 5th, ... *Subtract*, to .... *draw under;* 6th, ... *Protract*, to .... *draw forward;* and 7th, ... *Detract*, to .... *draw down.* We speak of retracting a ..... *statement;* of distracting our ..... *minds;* of detracting any one's ..... *character.* That will end this lesson.

LESSON XIV.

NATURAL SCIENCE: SOURCES OF HEAT.

I am always glad in commencing a lesson to see every one in such good ..... *position*, sitting .... *upright*, ... and .... *attending.*

Raise hands all who can remember how many effects of heat we mentioned in our former lesson upon that subject? (See Lesson v.) George ? . . . . *Three.* Three what ? . . . . *Three effects of heat.* What about them ? Learn to make a full statement about everything . . . . . *We mentioned three effects of heat in our former lesson.* Who knows the first one ? Bessie ? . . . . *Heat causes substances to expand, or become larger.* Good. Our lesson is commencing in excellent style. The second ? Willie ? . . . . . *Heat causes substances when very hot to emit, or send forth light.* That is correct, also. The third ? Mary ? . . . . . *Heat changes or converts solids into liquids, and liquids into gases.* Very good. We are now to proceed to the consideration of the sources of heat.

What is a source ? The place where a river rises is called its . . . . . *source.* When I hear whispering in the school-room, it comes from some . . . . . *source,* and I very naturally look around to . . . . . *find out the source of the whispering.* Instead of "find out" there is a better expression—one word—what is it ? . . . . *discover.* Well, can any of you discover any source of heat, that is, any place where we obtain heat, or any means of obtaining it ? Raise hands. Emily ? . . . . *Fire.* What about fire ? . . . . *Fire is one source of heat.* Any other ? Annie ? . . . . *The sun is a source of heat.* And since most of our heat is received from . . . . *the sun,* we will mention it as the first . . . . . *source of heat.* Before going any further, give me other words for received. I said that most of the earth's heat is . . . . . *received from the sun.* Any other word ? Sam ? . . . . *obtained.* Yes, I believe we have already used that word. Others ? Hands up. Kate ? . . . . . *Procured.* That is also a good word. Frank ? . . . . *Got.* Yes, the simple word . . . . *got,* is a good one. Any more ? George ? . . . . *Derived.* That I think is the best word. The source from which most of our . . . . *heat,* is . . . . . *derived,* is . . . . *the sun.* Now we will have Emily's answer . . . . *fire.* FIRE we will consider . . . . *the second source of heat.* Genie, you may repeat these two sources. . . . *The sun is the first, and fire the second source of heat.*

Now, I will ask for another source. But first I will give you a better word than fire. COMBUSTION. All answer this . . . . . *combustion.* This word means . . . . *fire.* Well, hands up for another source. Let us investigate. If you rub a metal button on a smooth board it becomes . . . . *hot.* Whence does the heat come? It is caused by the . . . . . *rubbing.* (Imitate the motion. Always use gestures where they will assist.) Can you not think of another word that is better than rubbing? Here is one. FRICTION. All repeat . . . . *friction,* or . . . . *rubbing,* is the . . . . *third source of heat.* Who will now mention all three? Alexander? . . . . *The first source of heat is the sun, the second is combustion or fire, and the third is friction or rubbing.*

Now we want other sources. When a gun is discharged where is the heat obtained that sets fire to the cap? It is caused by the striking of the hammer. A blacksmith can hammer a piece of iron until it becomes hot enough to kindle his fire! This may appear strange, but it is so. Then we have a fourth source of . . . . . *heat.* It is . . . . . *striking.* There is a better word. The caps sold for guns are not called "striking caps." Hands up those who know what they are called. Archie? . . . . *Percussion caps.* That is the word. Percussion means . . . . *striking.* The fourth source of . . . . *heat,* is . . . . *percussion.* 1st, we had . . . . . *The sun;* 2d, ... *Combustion;* 3d, ... *Friction;* 4th, ... *Percussion.* We will keep them written upon the blackboard so as to have them all in the same order. I suppose we have now had nearly all the sources of heat. Are there any others? All think. Have any of you ever seen water—cold water—poured upon quick-lime? I see many hands raised. Well, hands down. The lime and water become very . . . . *hot,* hot enough to . . . . *scald us.* Whence does the heat come? I would have thought that pouring cold water on it, would surely cool it instead of . . . . *heating it.* The heat here is caused by the ACTION of the lime and water. This kind of action is called CHEMICAL ACTION. It is this kind of action that causes the heat when wood burns. We will see this better in another lesson. I want to hear these two words from all . . . . . *Chemical action.* (A very fine experiment in illustration of this is to place sulphuric acid and cold water together in equal parts. The chemical action going on evolves much heat, although no action of any kind can be seen.) I now wish you, Lucy, to rise and give these five sources. . . . *The first source of heat is the sun, the second is combustion, the third is friction, the fourth is percussion, and the fifth chemical action.*

I wonder if we can find any other. Here is a boy who has his hand up. I can tell by his eyes that he has a good idea. Well, Fred ? . . . . *I know a man who had a hay-stack burned by the lightning.* Good. Another name for lightning is ELECTRICITY. I will write it. All answer this word . . . . *Electricity.* This is another source of heat. What is this last source, Charlie . . . . ? I thought he could not tell. Some boys allow what they hear to pass in at one ear and out at . . . . *the other.* You might as well pour water on a duck's back and try to . . . . . *wet it.* You tell him, Fred . . . . *electricity.* Now, Charlie ? . . . . *electricity.*

We have now mentioned . . . . *six sources.* This will be sufficient for the present. If any one thinks of others you may bring them to me at any time. The source is the place where anything is . . . . *obtained,* or . . . . *derived.* The first source of heat is . . . . *the sun.* 2d, ... *Combustion,* or . . . . *fire.* 3d, ... *Friction,* or . . . . *rubbing.* 4th, ... *Percussion,* or . . . . *striking.* 5th, ... *Chemical action.* 6th . . . . *Electricity,* or . . . . *lightning.*

I hope all will endeavor to remember this lesson. Our next upon heat will be to tell how it passes from one body to another, or is TRANSMITTED.

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LESSON XV.

PHYSIOLOGY: THE NERVES.

Now all sit upright "in position." You remember our rule about giving good . . . . *attention.* To attend means to . . . . *look and listen.*

We become acquainted with all that surrounds us by means of.... *the five senses.* (See Lesson VIII. on this subject,) which are, 1st, ... *Seeing.* 2d, ... *Hearing.* 3d, ... *Feeling.* 4th, ... *Tasting,* and 5th, ... *Smelling.* Anything that the mind receives through any of the senses is called .... *a sensation.*

Now, this lesson is upon those organs of the body along which these sensations travel in order to reach .... *the mind.* Can any one tell me what organs they are? James? .... *The nerves.* (If neither he nor any other can tell you, this fact must be stated.) That is correct, and I wish to tell you that the nerves, together with the brain, form what is called THE NERVOUS SYSTEM. What organs form the nervous system? Nellie? .... *The brain and the nerves form the nervous system.* Very well.

Can any one tell me how many kinds of nerves there are? Let us investigate it a little. When I wish to raise my arm, how do I do it? I will tell you. My mind issues an order which passes along a nerve to the muscle, causing it to contract or .... *draw together.* (See Lesson XIII.) When the muscle contracts, it draws up my arm. (To illustrate this, request them to grasp the muscle surrounding the upper arm tightly, midway between the elbow and shoulder, having the arm extended; then to slowly raise the lower arm, when the swelling of the muscle, caused by its contraction, is plainly felt. Explain that the contracting of the muscle is the cause of the arm's being raised.) The message, or as I before called it, the .... *order,* after being sent forth by my .... *mind,* travelled along a .... *nerve,* and thus reached the .... *muscle,* causing it to .... *contract.* You may repeat that Jane. (If she cannot, carefully state it again as before, or invert the sentence thus:) The message or .... *order,* that was sent from my mind to the .... *muscle,* travelled along a .... *nerve.* Now repeat, Jane .... *The message or order that passed from your mind to the muscle travelled along a nerve.* Raise hands all who can repeat it. (Do not leave it, till all can.) This is one kind of nerve. On this class of nerves, commands or .... *orders,* or .... *messages,* pass from the .... *mind,* to the ...., *muscles.* These nerves are called EFFERENT NERVES. All repeat . . . . . *efferent nerves.* What are efferent nerves? Annie? . . . . *Efferent nerves are those along which the commands of the mind pass outwards to the body.* Yes. This word is derived from two Latin words, FERO, to carry, and EX, out. But the X of EX, for the sake of the better sound, is changed to F; and so instead of Ex-ferent we have it thus—EFFERENT. Those nerves which "carry out" messages from . . . . *the mind,* are called . . . . *efferent nerves.*

We have now to speak of another class of nerves. You told me that anything passing in to the mind through one of the five . . . . *senses,* is called . . . . *a sensation.* And I told you that these . . . . *sensations,* passed over . . . . *the nerves,* in going to the . . . . . *mind.* Now the nerves along which these sensations pass, are not the same nerves that we have spoken of. They form another class. And because they carry . . . . *sensations,* in to the . . . . *mind,* they are described by a word which is derived from FERO, to carry, and AD, to. The D of AD is changed also to F. The word is AFFERENT. (Write all such words on the blackboard.) Afferent means . . . . *carrying to;* and the nerves which carry in . . . . *sensations,* to the . . . . . *mind,* are called . . . . . *afferent nerves.* George, repeat that . . . . *The nerves which carry in sensations to the mind are called afferent nerves.* (Call on several to repeat this, and do not leave it till all can do so, and even invert and transpose the sentence.)

Now all answer promptly. The nervous system consists of two . . . . . *parts,* the brain and the . . . . . *nerves.* The nerves again are divided into . . . . . *two classes,* which are called . . . . *efferent and afferent.* The efferent nerves are those that . . . . *carry commands out from the mind;* and the . . . . *afferent,* are those that . . . . . *carry sensations in to the mind.* The channels through which these sensations reach the mind are called the five . . . . *senses,* and the name sensation is used because it passes in through . . . . . *one of the senses.* (During the lesson call frequently for full statements of facts, or deductions from facts, from individual scholars, so as to secure assurance that the matters before them are comprehended, and to give them power over language. Occasionally allow them to write "a composition" upon the subject of the lesson.)

LESSON XVI.

MATHEMATICAL GEOGRAPHY: LINES UPON THE EARTH'S SURFACE.

Every eye must be directed towards me, and all must sit . . . . *upright*, and answer . . . *promptly*.

The earth's form is . . . . . *round like a ball*, (See Lesson III.) or . . . . *globular*, or . . . . *spherical*. And raise hands all who can tell me how many motions we described in our lesson on the motions of the earth. George? . . . . . *The earth has two motions; its rotatory motion and its revolutionary motion*. Very well expressed. Its revolutionary . . . . *motion*, is performed round . . . . *the sun;* and its . . . . *rotatory motion*, around . . . . *its own axis*. What is the earth's axis? Annie? . . . . *It is the imaginary line around which it turns*. Yes, and this imaginary line corresponds to the axle of . . . . *a wheel*. AXLE and AXIS are similar . . . . . *words*. They have almost the same . . . . *meaning*.

Now in this globe (an apple, wooden ball, or any round or spherical object will do as well) we have a representation of . . . . *the earth*. I will cause it to . . . . . *revolve*. It revolves on its . . . . *axis*. Has the earth a material axis like this globe has? . . . . *No, sir. Its axis is imaginary*. The ends of this axis are called . . . . *the poles*. This one is the . . . . *North Pole*, and this . . . . *the South Pole*. Now if, as I revolve this globe on its axis, I mark a line EXACTLY AT AN EQUAL DISTANCE FROM EACH POLE, this line receives a particular name. What is it? Hands up. Fred? . . . . *It is called the Equator*. (If not known, tell it.) That is correct. And its name indicates that it is at . . . . *an equal distance from each pole*. Bessie, repeat that . . . . *The name "equator" indicates that it is drawn at an equal distance from each pole*. Very well.

Now, can any one tell me whether the North Pole, the South Pole, or the Equator is situated exactly facing the sun? And if any of them is, which it is? I see no one knows. Neither of them is exactly opposite the sun, but the equator is nearest to it. It occupies this position. All look at me. If you suppose that boy's head to be the sun, and draw a line directly to this globe, will the axis of the globe be at right angles to this line? Look how I hold it .... *No, sir.* Can you tell me how far the earth's axis is from being at right angles? I will endeavor to explain how far. Every circle is supposed to be divided in 360 equal parts, called degrees. How many degrees in half a circle of any size? .... 180 *degrees.* (Explain on the blackboard, etc., that it holds good for circles of any size. In large circles the degrees will be larger, but still there are only 360 degrees in the circle, however large.) In a quarter of a circle? .... 90 *degrees.* Willie, repeat that statement in full .... *In a quarter of a circle there are* 90 *degrees.* In an eighth of a circle there would be half of .... 90 *degrees,* which is .... 45 *degrees.* That would be about like this: (Draw a line horizontally, another at right angles to it, and a third between the two at 45 degrees inclination to each of them.) This last line I drew is INCLINED. All repeat this word .... *Inclined.* It is said to be inclined about 45 degrees from the perpendicular line. Again, the last line I drew is .... *inclined* 45 *degrees from the perpendicular line.* Ella, you may repeat that. (She repeats.) Now, the earth's axis is inclined only a little more than half as much as that from a perpendicular line. It is inclined 23½ degrees. What is, Charlie? .... *The earth's axis.* What about the earth's axis? I want to see if you really were attending? .... *The earth's axis is inclined* 23½ *degrees from a line drawn perpendicular to the line extending from the sun to the earth.* (Now get some one to repeat, and use the words "at right angles" instead of "perpendicular." Cause all to be able to repeat it before leaving it.)

Then let us revise a little. The imaginary line on which the earth .... *rotates,* is called its .... *axis.* The ends of this axis are .... *the poles.* If we suppose a line drawn from the sun to .... *the earth,* the axis of the earth is not at right angles or .... *perpendicular,* to this .... *line,* but is inclined from the perpendicular about .... 23½ *degrees.* What is a degree? It is one of the equal .... *parts,* of which there are .... 360 *in a circle.* Lettie, repeat that. (She repeats.)

If the North Pole were inclined just one degree from the perpendicular towards the sun, would the people at the equator have the sun directly overhead? .... *No, sir.* It would be just one degree north of the point that was .... *overhead.* Well, observe closely. (Carry the globe round to the opposite side of the sun, keeping its axis pointing in the same absolute direction, so that when it has passed half way round, the distance the earth travels in six months, the opposite or South Pole will now be inclined one degree toward the sun from the perpendicular, and the North Pole one degree away from the sun.) The earth has now revolved six months and has gone half way round .... *the sun.* Remark that the axis always remains parallel to itself, that is, it always points in the same general .... *direction.* Now, would the people at the equator have the sun one degree NORTH of the point overhead? .... *No, sir, South.* Well, since the earth's axis is 23½ degrees inclined, the inhabitants living at the equator, when the earth is at the first point that I represented just now (carry it back where you started) would have the sun how far from the point overhead? .... 23½ *degrees.* Which way? .... *North.* And the sun would be shining overhead to people living 23½ degrees north of .... *the equator.* If we now draw a line through this point as the earth rotates, this line represents the TROPIC OF CANCER. And when the earth has revolved half way round again, the sun would be .... *overhead,* to people who live .... 23½ *degrees south of the equator*; and a line drawn through this point round the earth, parallel to the equator, is the TROPIC OF CAPRICORN. Raise hands all who will tell me the name of the northern tropic. Fannie? .... *The Northern tropic is the Tropic of Cancer.* The Southern one, David? .... *The Southern tropic is the Tropic of Capricorn.* (Here commence and rapidly revise or recapitulate the whole lesson.)

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LESSON XVII.

NATURAL SCIENCE—CLIMATE ; ITS CAUSES.

Now all must be very . . . . *attentive*, while we revise our lesson on the elements of climate.

The elements of anything are those that . . . . *compose it*, or . . . . *make it up*. There are how many elements of climate? . . . . *Three.* (See Lesson i.) These are, 1st, ... *temperature*, or . . . . *the heat or cold;* 2d, ... *moisture*, or the state of . . . . *being wet or dry*, and 3d, ... *prevailing winds.* Those climates that are too cold in . . . . *winter*, or . . . . *too hot in summer*, are called . . . . *extreme*, while those that are neither too cold nor . . . . *too hot*, are called . . . . *temperate.*

We are to speak to-day of the CAUSES of climate. If you wished to know whether a country had a wet or dry, cold or . . . . *hot*, or a stormy . . . . *climate*, what would you ask about it in order to decide this? All try and think of this. How can we tell what variety of climate any country has? What must we know before we can tell? Let us investigate it a little.

When we conducted our lesson on the lines on the earth's surface (See Lesson xvi.) we stated that the earth, in its motion like a wheel, revolves around an imaginary line called its . . . . *axis.* The ends of this axis are called . . . . *poles*, the North and . . . . *South Poles.* There is a line, then, which, because it is drawn AT AN EQUAL DISTANCE FROM EACH POLE, is called . . . . *the equator.* I wish to tell you now that the countries where the sun shines directly over . . . . *head*, or . . . . *perpendicularly*, are those that are near this line, the . . . . *equator.* (Use a globe if you have one, or at least a map here.) Here, 23½ degrees north of the . . . . *equator*, is another line called . . . . *the Tropic of Cancer*, and 23½ degrees south of the equator is . . . . *the Tropic of Capricorn.* How many degrees are there between these two tropics? . . . . 47 *degrees.* And countries lying anywhere between the tropics are called . . . . ? They are called INTERTROPICAL. What are intertropical countries?

Hands up. Fred? . . . . . *Intertropical countries are those lying between tropics.* And since these countries have the sun almost directly . . . . *overhead*, they will have a . . . . *hot climate.* And if we go nearer to the poles it becomes . . . . *colder*, till at last at the polar regions we would find only . . . . *ice and snow*, all the year round. Now listen while I state the first cause of climate in a few words. DISTANCE NORTH OR SOUTH OF THE EQUATOR. Emily, give the first cause of climate again . . . . *The first cause of climate is distance north or south of the equator.* I will call for this again.

Does any other cause affect climate? All think. You said it would be hot near the . . . . *equator.* Well, I can tell you of places between the tropics where there is abundance of snow . . . . *Yes, sir; on the tops of high mountains.* So that it will make some difference whether a country is . . . . *high or low*; that is, whether it is high above the level of the sea. Now, who will state this second cause of climate? George? . . . . *Height above the level of the sea.* Can any one give me a word that will be better than height? Let me give you one. I will write it on our blackboard. ELEVATION. Will you repeat your definition, George, and use this word? . . . . *The second cause of climate is elevation above the sea level.* Those countries that are high and mountainous will have . . . . *cold climates*; well, we will say colder climates than those that are . . . . *at the sea level.*

All answer promptly. 23½ degrees on either side of . . . . *the equator*, are the two . . . . *tropics*, including those countries that are called . . . . *intertropical.* These countries have . . . . *hot climates.* We said that the first cause of . . . . *climate*, is . . . . *distance north or south of the equator*; and the second . . . . *elevation above the sea level.* Those countries bordering on the equator have hot . . . . *climates*, while those toward the . . . . *poles*, will have . . . . *colder climates.* And elevated or . . . . *high*, countries will be . . . . *colder*, than those at the level of . . . . *the sea.*

Well, has any one thought of any other cause? Will Minnesota have a similar climate to an island such as Great Britain? You see by the map that Britain is much farther north than . . . . *Minnesota*, but I will tell you that it is never as cold as zero in winter, or very warm in summer. Indeed, their rivers are very rarely frozen over firmly enough to skate on. Now, why should there be such a difference? George? .... *The water of the sea keeps an island warm in winter and cool in summer.* Very well answered. And in the centre of a .... *continent* (point to the continent of North America) the wind in winter blows over immense fields of.... *snow or ice,* and keeps the air .... *cold,* intensely ..... *cold,* and in summer the wind comes across the heated land, and of course, must be very .... *warm.* Indeed countries in the centre of a .... *continent,* have what kind of a climate? What kind of climates are those that are too hot in summer and too cold in winter? ..... *Extreme climates.* What about extreme climates? Mary? .... *Countries in the middle of a continent have extreme climates.* Who can think of a better word than middle, or centre? George? .... *Interior.* Well, George, state it and use this word. (He states it again.) And islands will have .... *temperate climates.* How then will we state the third cause? Let me do it. THE NEARNESS OF LARGE TRACTS OF LAND OR WATER. But there is a much better word than nearness. What is it? Archie? ..... *closeness.* Well, any other? I will write it. PROXIMITY. The third cause of climate is .... *the proximity of large tracts of land or water.* Libbie, repeat that. (She repeats.)

There are a few other causes, but we have the three principal ones. 1st, ... *Distance north or south of the equator.* 2d, ... *Elevation above the level of the sea.* 3d, ... *Proximity of large tracts of land or water.*

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LESSON XVIII.

ANATOMY: OSSEOUS SYSTEM.

Diligent scholars are always found to be among those who advance in study. And the very first thing that indicates diligence is giving good .... *attention.*

Our bodies are made up of a great number of different .... *parts;* another word .... *organs,* which perform a great many functions. And in order to give support and firmness to these different .... *organs,* the body is built, so to speak, on a strong framework. This framework of our .... *bodies,* consists of the .... *bones.* We will have a lesson to-day on the bones of the body.

First, then, is a strong column in the back which is made of a number of .... *bones,* all strongly fastened .... *together.* They are called by a name which I wish to hear you all pronounce, when I write it on the blackboard. It is VERTEBRÆ. Let me hear it from all together .... *Vertebræ.* One of these bones is called a VERTEBRA; and the plural is .... *vertebræ.* Now, all answer together. The backbone is composed of a number of .... *bones,* called .... *vertebræ,* each bone being called a .... *vertebra.* The whole together is generally known as the VERTEBRAL COLUMN. Willie, you may repeat the last sentence .... *The vertebræ are often called the vertebral column.* This column of .... *bones,* is the central framework of the .... *body,* and to them all the others are ..... *fastened,* or .... *attached.*

I said that all these bones are fastened strongly, ... *together.* Do you know the name of the substance with which they are fastened? It is called CARTILAGE or GRISTLE; or these fastenings that bind bones together are often called LIGAMENTS. I will repeat the sentence to hear you pronounce these words. The bones are firmly .... *fastened together,* with strong bands or ..... *ligaments,* which consist of .... *cartilage,* or .... *gristle.*

We will next refer to the bones of the leg. We will only need to name those of one leg. First, from the hip to the knee is a long .... *bone,* called the FEMUR. All pronounce this ..... *Femur;* and when we speak of the two, we call them FEMORA—not FEMURS. We would say the two .... *femora.* These are the bones of the .... *thighs.* From the knee to the ankle are two bones. The larger and stronger of these is called the TIBIA, and the smaller the FIBULA. Repeat that, Willie .... *The larger of the two leg bones is the tibia, and the smaller the fibula.* What is the thigh bone called? David? ..... *The thigh bone is called the femur.*

There are a number of bones in the ankle. They go under the name of TARSUS. The ankle is called the .... *tarsus.* And the prefix META means beyond. Now, of what will METATARSUS be the name? George? .... *The bones of the foot would be the metatarsus, because they are beyond the tarsus.* And after this come the bones of the toes. They are called by the same name as the bones of the fingers. They are called PHALANGES. (Sound the E long, as though EE.) This is a Latin word, and means RANKS. It was applied to the ranks of men in an army. The first row, or .... *rank,* would be called the first PHALANX. And the second row would be ..... *the second phalanx,* and so on. And since these bones are in rows, connected by joints, they are called .... *phalanges.* Each row is a .... *phalanx.* The ankle bones form the .... *tarsus,* the foot the .... *metatarsus,* and the toes .... *the phalanges.*

Next is the arm. From the shoulder to the .... *elbow,* is one bone called the HUMERUS. This is also called the upper .... *arm bone.* Then there are two bones in the lower .... *arm,* just as there were in the .... *leg.* But they have different .... *names.* The one attached on the side of the wrist next the thumb is the RADIUS, the other the ULNA. You can remember them in this way. Place your arm and .... *hand,* flat on a .... *board,* and then turn the hand completely over. The radius, which is attached nearest to the .... *thumb,* turns round the .... *ulna.* When we turn our hand over, then the bone which is turning round the ..... *other,* is ..... *the radius,* and that around which it turns, is ..... *the ulna.* You may name the bones of the arm again. 1st, ... *The humerus,* or .... *upper arm.* 2d, ... *The radius and ulna,* or bones of .... *the lower arm.* Then the wrist bones receive the name CARPUS; and, like the metatarsus, beyond the .... *carpus,* will be the .... *metacarpus,* or the palm of the .... *hand.* And the fingers we have already called the .... *phalanges.*

The bones of the head will form the subject of another lesson. But we still have several others. The breast-bone receives the name of STERNUM. Repeat that, Frank . . . . *The breast-bone is called the sternum.* And between it and the bones of the . . . . *back*, or, as we called them, the . . . . *vertebral column*, are several long bones called the . . . . *ribs.*

Then from the breast-bone or . . . . *sternum*, a long bone extends to the shoulder. It is called the CLAVICLE, or COLLAR BONE. You can easily feel it in the . . . . *neck.* Its name, again, is . . . . . *the clavicle.* Attached to the back-bone is the shoulder-blade, which is called the SCAPULA. The collar-bone is the . . . . *clavicle*, and the shoulder-blade the . . . . *scapula.*

As I point to the different bones in this boy's body, you may answer their . . . . *names.* 1st, ... *the vertebral column;* 2d, ... *the femora;* 3d, ... *the tibia*, and . . . . *fibula;* 4th, ... *the tarsus;* 5th, ... *the metatarsus;* 6th, ... *the phalanges;* 7th, ... *the humerus;* 8th, ... *the radius*, and . . . . *ulna;* 9th, ... *the carpus;* 10th, ... *the metacarpus;* 11th, ... *the phalanges;* 12th, ... *the sternum;* 13th, ... *the ribs;* 14th, ... *the clavicle;* 15th, ... *the scapula.* The bones of the . . . . *head*, we leave for another . . . . *lesson.*

(This lesson may be divided into three or more parts, at the discretion of the teacher, according to the advancement and capabilities of the scholars. The same will apply to other lessons. What you do, be sure and do WELL, however SLOWLY.)

LESSON XIX.

NATURAL SCIENCE: ORGANIC AND INORGANIC BODIES.

I observe two boys not in a proper position. They may stand up. A good position is necessary to secure good . . . . *attention.*

Our lesson to-day is about ORGANIC AND INORGANIC BODIES. Who can tell me what an organic body is? I see several hands up. I want to see what kind of answers we will receive. Fred? . . . . *An animal.* Mary? . . . . *Animals and plants.* George? . . . . *My answer was like the last.* Well, would milk be organic or not? Sarah? . . . . *Organic.* And it is neither an animal nor a . . . . *plant.* I see that you will be able to tell better after our lesson has proceeded further. The boys who are standing may now sit.

An animal's body consists (See Lesson IV.) of a collection of . . . . ? The eye is an . . . . *organ.* The nerves are . . . . *organs.* The skin is an . . . . *organ,* and the whole body is a collection of . . . . *organs.* Each organ performs some . . . . *function.* Now do you think plants have any organs? Well, Sam? . . . . *Are the leaves of plants organs?* Yes, they are. I am happy to know that we have one boy who thinks some. Have they any other organs? George? . . . . *The roots, I think, would be called organs.* You are correct. Do you think the sap is an organ? or the blood of an animal? or milk? . . . . *No, sir.* No, they are not. But they are produced by certain . . . . *organs.* Is gum an organ of a tree? . . . . *No, sir.* You think it is not, for it does not perform any . . . . *function.* But since flowers are necessary to produce fruit, they are . . . . *organs.* So is the bark, for if it is stripped off, the plant or tree . . . . *dies.* The organs of plants, I now wish to tell you, are called ORGANIC. And so are all those substances produced by these organs. Is the starch of a potato organic, or not? Alice? . . . . *Yes, sir; the starch of potatoes is organic.* Is sugar organic, or not? Lizzie? . . . . *Yes, sir; sugar is organic.* Why? . . . . *It is organic because it is produced by the organs of plants.* Very well. What would you say of wine? Annie . . . . *I think it is organic.* You think so because it is . . . . *produced,* by the organs of plants. Anything that is produced, then, by the . . . . *organs of plants,* as well as these organs themselves, will be . . . . *organic.*

Now how is it about animals? The same will be true of them. Every part of an . . . . *animal,* is . . . . *organic.* And anything that is the product of . . . . *animals,* is also . . . . *organic.* Raise hands those who can give me examples of organic substances from animals. I want to see every hand raised. Try and think of them. Well, Willie? . . . .

Leather is organic. Good. George? . . . . *Butter is organic.* Lizzie? . . . . *Woolen cloth.* Very good. Allie . . . . *Combs that are made of horn are organic.* Or in two words . . . . *horn combs.* Thomas? . . . . *Glue is organic.* Fannie? . . . . *Fur is organic.* Well, that is sufficient. Hands down. Is India-rubber organic? Charlie? . . . . *Yes, sir; it is made from the sap of a tree.* All these various . . . . *substances,* and many . . . . *others,* which we have not . . . . . *mentioned,* are . . . . *organic.*

Now raise hands those who can tell me what an organic substance is. Henry? . . . . *An organic substance is either an organ of a plant or animal, or it is some product of the organs of plants or animals.* That is an excellent definition. Now who can repeat it? Hands up. All whose hands are not raised will remain at recess and write it three times upon their slates. George, you will please write it for them on the blackboard.

We want to continue this lesson a little further. What would you call pure water? Is it organic? . . . . . *No, sir.* What is the opposite of organic? Place the prefix IN before it. All answer . . . . *Inorganic.* This word means . . . . . *not organic.* Water, then, is . . . . . *inorganic.* Give me other inorganic substances. Hands up. Harry? . . . . *Glass.* Mary? . . . . . *Paper.* What, is paper inorganic? What is it made of? . . . . *Rags, straw, etc.* And are these not organic? Then paper, Mary, is . . . . . *organic.* Well, Charlie? . . . . *Iron.* Yes, that is correct. George? . . . . *Granite rock.* Good. Emma? . . . . *Sand.* These things are all . . . . . *inorganic,* because they are neither produced from the organs of . . . . *plants or animals,* nor are they the . . . . *organs themselves.*

The whole world, then, is made up or . . . . *composed,* of these two kinds of . . . . *matter.* What kinds? Bessie? . . . . *Organic and Inorganic.* Make the whole statement . . . . . *The whole world is composed of two kinds of matter, Organic and Inorganic.*

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LESSON XX.

PHYSIOLOGY: CIRCULATION OF THE BLOOD.

Every eye must be directed toward your teacher, and every voice must be heard in giving each . . . . *answer.* To answer properly you have to give good . . . . *attention.*

Every animal's body contains a fluid, generally of a red color, which nourishes it. When any part of the flesh is cut, this fluid flows out. It is called . . . . *the blood.* The blood is a . . . . *fluid,* which is found in the bodies of . . . . *animals.* It is of a red . . . . *color.* We are to speak to-day of the blood, and how it circulates through the body. When I say that it circulates, I mean . . . . ? What do I mean when I say that money circulates? Frank? . . . . *You mean that it moves round.* And if I say that the blood circulates I mean that it . . . . *moves round.* It moves round or . . . . *circulates,* through . . . . *the body.* A long time ago people did not know that the blood was continually . . . . *running through the body,* or . . . . *circulating* It was discovered by a man whose name was HARVEY about the year 1615. Previous to this the blood was not known to . . . . *circulate.* I will tell you how you can each prove that it does . . . . *circulate.* If you take a delicate membrane of a living animal, such as the web of a frog's foot, and look into it carefully through a microscope, holding it in the sunshine, you will see the particles of . . . . *blood,* moving through the minute blood-vessels. This will prove, Annie, that . . . . *the blood circulates.* I used the word particles just now. I want a better word. Well, as there are no hands up, I will write two. CORPUSCULES and GLOBULES. You may all repeat these words as I point to them . . . . *Corpuscules,* and . . . . *Globules.* When you cut the hand what happens? Sam? . . . . *It bleeds.* Very well.; and after it has ceased bleeding, did you ever see another clear liquid, much like the white of an egg, flow out slowly? . . . . *Yes, sir.* Now the globules or . . . . *corpuscules,* are floating in this clear liquid. Do you know their shape? They are not round like shot, nor like grains of sand, nor like split peas, but, strange as it may appear, they resemble cents, or other coins. An object of the shape of . . . . *a cent*, is called a DISC. All repeat . . . . *a disc.* What about a disc, Susan? . . . . *An object of the shape of a cent is called a disc.* George, you may give the shape of the globules of blood . . . . *The globules or corpuscules of blood are small discs.* That means that they are of the shape of . . . . *coins.* And I have told you that if you look carefully into the . . . . *web of a frog's foot*, you can see these . . . . *globules*, of the shape of . . . . *coins*, sliding through the small . . . . . *blood-vessels*, thus showing that the blood continually . . . . *circulates.*

In speaking of organs and their functions, we remarked that the organ which circulates the . . . . *blood*, is . . . . *the heart.* (See Lesson IV.) How does the heart circulate it? Are there any other organs required? . . . . *Yes, sir; the blood-vessels.* Is not the heart a blood-vessel? A blood-vessel is simply a vessel that contains . . . . *blood*, just as a school-house is a house used for . . . . *a school.* I will tell you that different names are given to different blood-vessels, but they may all be called by one general name. I will write it. THE CIRCULATORY SYSTEM. Why is it so called? Mary? . . . . *Because it is the system of vessels through which the blood circulates.* Very well expressed indeed. James, you may also give that statement. (He gives it.) Of how many parts does this circulatory system consist? We will see.

First there is the organ that causes it to . . . . *circulate*, that is . . . . *the heart.* Then the blood flows from the heart through a number of long tubes throughout the whole . . . . . *body.* These tubes are called ARTERIES. What about arteries, Genie? . . . . *The tubes that lead the blood from the heart to the body are called arteries.* In the third place there is another set of tubes, different from the arteries, which conduct the . . . . *blood*, back again from the body to the . . . . . *heart.* These are the VEINS. Raise hands all who can tell the difference between arteries and veins? Emily? . . . . *The arteries carry the blood from the heart to the different parts of the body, while the veins conduct it back to the heart.* That is well done. But I observed several whose hands were not raised. We will repeat.

The first part of the circulatory system is, ... *the heart;* 2d, ... *the arteries;* and 3d, ... *the veins.*

But now I will ask a puzzling question: How does the blood get out of the arteries into the veins? Let me tell you. At first, the blood flows through only one artery. This one branches into two parts, one which goes . . . . *downwards* (use gestures) and one . . . . *upwards.* Then these separate into different . . . . *branches,* and each branch becomes divided up, so as to send a small artery to each of the different . . . . *parts.* At last these divide up into very minute vessels, the name of which I will write upon the board. CAPILLARY VESSELS. There is another name. CELLULAR TISSUE. It is called so because the vessels are so small as to appear like a tissue of small cells. All may give me the first name again . . . . *Capillary vessels.* And the other . . . . *Cellular tissue.* We will use the first name. The blood flows out of the arteries into . . . . *the capillary vessels,* through which it passes into the veins. How does the blood get from the arteries into the veins? George? . . . . *It flows through the capillary vessels, which join the ends of the arteries to the ends of the veins.* Very well.

These four parts, the heart, the arteries, the capillary vessels and the . . . . *veins,* form a complete set or SYSTEM of vessels, which receive the name of "THE CIRCULATORY SYSTEM," because through this . . . . *system of vessels,* the blood . . . . *circulates.* This circulatory . . . . *system,* then, consists of, 1st, ... *The heart;* 2d, ... *The arteries;* 3d, ... *The capillary vessels;* 4th, ... *The veins.* The organ which causes the blood to circulate is . . . . *the heart.* It forces the blood into the . . . . *arteries,* from them it flows through the . . . . *capillary vessels,* into . . . . *the veins,* from which it again enters . . . . *the heart,* to be again sent or . . . . *circulated,* through . . . . *the body.* The difference between the arteries and the veins is, that the arteries carry the . . . . *blood from the heart to the body,* whereas, Archie, the veins . . . . *carry it back from the body to the heart.*

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LESSON XXI.

CHEMISTRY—OXYGEN : FLAME.

The best method to obtain the full amount of benefit from a lesson is to give strict . . . . *attention.*

The air is composed (See Lesson XI.) of several different kinds of . . . . *gas.* The two principal gases are, 1st, ... *oxygen*, which is the most . . . . *important*, and 2d, ... *nitrogen.* The nitrogen is mixed with the . . . . *oxygen*, in order to . . . . *dilute it*, that is, to make it not quite so . . . . *strong.* With one part of oxygen are mixed . . . . *four parts of nitrogen.* And so we say that the air is one-fifth . . . . *oxygen*, and . . . . *four-fifths nitrogen.* The oxygen, again, you tell me is the most . . . . *important*, of these two . . . . *gases.* We are to speak of this gas in our lesson to-day.

When we breathe in the . . . . *air*, it consists of . . . . *oxygen and nitrogen.* Now I will tell you that while it is in our . . . . ? What are the organs of breathing? (See Lesson IV.) James? . . . . *The lungs.* While the air is in . . . . *our lungs*, ITS OXYGEN IS TAKEN UP BY THE BLOOD. Aggie, repeat that. Here is a girl who has not been attending. Do you not feel ashamed to see such a forest of hands all around you? Emily? . . . . *While the air is in our lungs its oxygen is taken up by the blood.* Who can give me a better term for "taken up?" . . . . Emma? . . . . *Abstracted.* That is an excellent word. Is there another? I will write one. ABSORBED. The oxygen is . . . . . *absorbed*, or . . . . . *abstracted*, or . . . . *taken away*, by . . . . *the blood*, while the air is in . . . . *the lungs.* And when we breathe out again, the air that comes forth must be the . . . . ? What other gas went in with oxygen, to dilute it? . . . . *Nitrogen.* Well, if the oxygen is taken from it by the . . . . *blood*, or, in other words, if the oxygen is . . . . *absorbed by the blood*, the air that comes forth from the lungs must be . . . . *nitrogen.* Yes. If wheat and chaff are put through a fanning mill, and the wheat is taken away while going through, what would come forth alone? . . . . *The chaff.* But we breathe out other things besides the nitrogen. I will tell you of them in our lesson on ANIMAL RESPIRATION. (See Lesson XXVI.)

Now, I want you all to watch closely what I do. I have here a large glass .... *jar*, which has a very large .... *neck*. (A confectionery jar will suit.) Here I also have .... *a piece of candle* (about an inch or two long), which I will light. I will now drop some melted tallow on this board, and thus cause the candle to adhere to it without any .... *candlestick*, for that would make it too ..... *large*. You now see that the candle burns quite .... *well;* another word .... *readily*. Why does it burn? Let me explain. You told me once that heat would change solids .... *into liquids*, and .... *liquids into gases*. Well, the heat of the flame changes the solid .... *tallow*, to .... *a liquid*. It then changes the .... *liquid*, to the form of .... *a gas*. This gas is hot, and as it ascends, the heat of the flame causes it to UNITE or COMBINE with the oxygen, which you told me we find in .... *the air*. This union or combination of the evaporated .... *tallow*, with the .... *oxygen*, we call FLAME. It is another kind of CHEMICAL ACTION. When did we ever speak of chemical action before? .... *In our lesson on the sources of heat*. Now, I am going to find out all in this room who can reason well. Suppose I put this jar over the ..... *candle*, and allow it to ..... *burn inside the jar*, where there is only very little .... *oxygen*, and where no more oxygen can .... *enter*, after it is all .... *used up*, what do you think would happen to the flame? Hands up. Why here are actually two girls and a boy who cannot tell! Can you tell me this? When all the tallow is gone, what would happen to the flame? .... *It would go out*. Most certainly it would. Well, hands down. And, you think if all the oxygen in the jar becomes .... *used up*, the .... *candle will go out*. There, you see, it has just gone out! That was because there was no more.... *oxygen*. I heard one boy say tallow. All the oxygen was .... *used up*. Now that we have got through with the experiment, I will ask for a better term than "used up." Mary? .... *Gone*. Fred? .... *Burnt up*. George? ..... *Exhausted.*[*] These were all good words, but the last one we will use. The oxygen all became .... *exhausted*, or .... *used up*, and consequently the candle . . . . *went out*, or was . . . . . *extinguished.* But there was still plenty of nitrogen ; why should it not burn there just as well? Emma? . . . . *You told us that the nitrogen was only to dilute the oxygen.* There is a girl who has a good memory. That is correct. It was for this reason that I told you that the oxygen was the most . . . . *important.*

Now I will tell you a little anecdote. You may assist me by elliptical answers ; that is, by filling up the pauses that I make. This country is . . . . *India.* In the Presidency of . . . . *Bengal*, is the city to which I now point . . . . *Calcutta.* All answer again . . . . *Calcutta.* A Hindoo monarch once took one hundred and forty-six men as prisoners at this city. He then shut them up in a dungeon that had only one means of admitting the light. That was where they entered. Because it was so black or dark, it was always afterwards known as "The Black Hole of Calcutta." This would be just what I did with the . . . . *candle.* He shut them up in the . . . . *black hole*, where there was not much . . . . *air.* And what do you think became of them? Harry? . . . . *They died.* Yes, all but twenty-three of them died! How many died? *One hundred and twenty-three of them died.* When they went to take these prisoners out, only . . . . *twenty-three of them were alive.* Now do you think it would do for us to remain in the school-room all day without having the windows or doors occasionally opened to let in the air? . . . . *No, sir.* No, we continually require fresh . . . . *air*, that contains good, wholesome . . . . *oxygen.*

When we breathe we take in . . . . *oxygen and nitrogen.* While in our . . . . *lungs*, the oxygen . . . . *is absorbed.* Then only the nitrogen . . . . *is left.* When a flame . . . . *burns*, the material that burns is . . . . *emitting*, or . . . . *combining*, with . . . . *oxygen.* (Point to such words on the board as you want.) If we burn a candle in a jar, into which no oxygen can enter, the candle . . . . *soon goes out*, or becomes . . . . *extinguished.* Neither fire would . . . . *burn*, nor life . . . . *continue*, if we were deprived of . . . . *oxygen.*

LESSON XXII.

PHYSIOLOGY: CIRCULATION OF THE BLOOD.

The girl who spoke just now may raise her right hand. No one? Any one who knows who spoke may raise his hand. Ella, you will leave your place, and write the first ten lines of your reading lesson on your slate. This is for speaking. You will also remain at recess. This will be for not acknowledging that you spoke. And the girl to whom she spoke will also remain with her for not letting me know.

Our lesson this morning is on a subject of which we have already spoken, "The Circulation of the Blood." (See Lesson xx.) The blood circulates through a number of vessels that form a complete . . . . *system*, called the . . . . *circulatory system*. This system consists of . . . . *four parts;* 1st, ... *The heart;* 2d, ... *The arteries;* 3d, ... *The capillary vessels*, and 4th, ... *The veins*. The blood flows from the veins into . . . . *the heart*. This organ forces it into . . . . *the arteries*, from which it passes through the . . . . *capillary vessels*, into . . . . *the veins*, and on again in the same . . . . *manner*, throughout the circulatory . . . . *system*. We wish to describe this system of blood-vessels more minutely in our lesson to-day. So all must be very . . . . *attentive*, and answer . . . . *promptly*.

If the blood flows through the heart it must have some space in it, or it must be . . . . *hollow*. How many spaces are there in the heart? I will tell you; there are four spaces in . . . . . *the heart*. Two of them are above, and two . . . . . *below*. The two upper spaces are smaller than the two lower ones. They are called AURICLES. One is the RIGHT AURICLE and the other will be the . . . . . *left auricle*. LEFT AURICLE. (Write these names.) Auricle means LITTLE EAR; and the auricles of the . . . . *heart*, are so called on account of their shape being similar to that of the . . . . . *ears*. Then the two lower spaces are called VENTRICLES. One will be the . . . . *right ventricle*, and the other . . . . *the left ventricle*. I have just told you that the ventricles are larger than .... *the auricles.* Was that just as we said it? .... *No, sir.* How did we state it before? Louisa? .... *The auricles are smaller than the ventricles.* Very good; and consequently the lower spaces or ..... *ventricles,* are .... *larger than the auricles.*

Now, before we go on, give me a better word than "spaces." A space would be a space still, even if it were not enclosed by walls. We can imagine an inch space in this large ..... *room.* I want a word which means an enclosed space. Let me write it. COMPARTMENT. What does it mean, James? .... *An enclosed space.* And since the heart has four enclosed .... *spaces,* we will call them the four .... *compartments of the heart.*

Well, if you will all endeavor to remember it, I will tell you that the veins all unite or .... *join,* and form at last only one .... *vein.* This vein enters the RIGHT AURICLE. Raise hands all who can state which compartment the blood enters from the veins. Here are two who evidently were not attending. They fail to raise their .... *hands.* Well, Carrie? .... *The blood first enters the right auricle.* This is the upper, right hand .... *compartment.* It is then forced out of the right .... *auricle,* downwards, into the right .... *ventricle.* This is the lower, right hand .... *compartment.* When this is full it contracts, or .... *draws together,* (See Lesson XIII.) and causes the blood to flow into THE LUNGS. It is in the lungs that it is supplied with air while we .... *breathe.* It is then conducted back to the left auricle, out of which it flows into the left .... *ventricle,* which is immediately below the left ..... *auricle.* From the left ventricle it flows into the ARTERIES, and you know its course after this. It flows out of the .... *arteries,* into .... *the veins.* Then it goes back to the .... *heart,* and follows the same course over again. (Revise this once or twice. Give this lesson at least six times, but not in succession. Make a circle on the blackboard, and divide it into four equal parts. Place the letters R. A., L. A., R. V., L. V., and make a rough representation of the lungs, arteries and veins. Arteries carry the blood into the lungs, and the veins carry it back to the L. A.) You may be anxious to know how the blood gets from one place to another, or what causes it to move. I will tell you this in another lesson.

LESSON XXIII.

NATURAL SCIENCE: EVAPORATION OF WATER.

Now, I wish to see every scholar endeavoring to receive the full benefit of the .... *lesson.* To do this, it is necessary to give strict .... *attention,* so as to be able to .... *answer promptly.* Every eye this .... *way.*

Heat converts solids .... *into liquids* (See Lessons v. and x.) and .... *liquids into gases.* The conversion of a liquid like water into a .... *gas,* like .... *steam,* that is, into a gaseous form, is called .... ? Do you not remember that we said that the process of changing water to vapor was called EVAPORATION? All repeat this word .... *Evaporation.* This means the process of .... *changing water to steam.* Our lesson to-day is upon this subject. All listen attentively as we proceed.

In order to cause the water to evaporate, we require to .... *heat it.* The heat will cause it to ..... *evaporate.* Well, suppose we place a kettle of water on the fire, and allow it to become .... *hot,* it will get hotter and hotter until at last it ..... ? What do you call that bubbling motion of the hot water? .... *Boiling.* At last, then, it would .... *boil.* Now I wish to tell you that after the water in an ordinary kettle or pot has begun to boil, IT CANNOT BE MADE ANY HOTTER! No matter how long we keep it on the .... *fire,* unless it is in a tight vessel like the boiler of a steam-engine, where the steam cannot .... *get out,* or .... *escape,* it cannot be made any .... *hotter.* Is not this a curious thing? We keep heating the water, that is, adding more .... *heat to it,* but cannot increase its .... *heat.* Why is this? Where does the heat go? What becomes of it? Let us investigate this matter.

Can any one tell me, first, how hot water must get before it boils? George? . . . . *212 degrees.* The water must have its temperature raised to . . . . *212 degrees*, before it will . . . . *boil*, and I have told you that it cannot be made any hotter in the open air than . . . . *212 degrees*, which, George says, is the point of heat at which it . . . . *boils.* We stated in a former lesson that the air presses on the earth's . . . . *surface*, with a pressure of . . . . *15 pounds on every square inch.* Now, as the water becomes hot, the heat is used up in forming . . . . *steam.* The steam tries to get out of the water (so to speak) rapidly as it occupies so much more . . . . *space*, than the . . . . *water;* but the pressure of the air keeps it in as long as it can, till, at last, when the water reaches the heat of . . . . *212 degrees*, the air by its . . . . *pressure*, can no longer keep the vapor in the . . . . *water*, and so it comes out in the process of boiling. Then when the water begins to . . . . *boil*, all the heat that enters it is used up in forming steam or . . . . *vapor*, which escapes as rapidly as it is . . . . *formed.* This vapor it is that carries off the heat. This is the reason, then, that the water cannot be made any . . . . *hotter*, after reaching the temperature of . . . . *212 degrees.*

Now will any one tell me another term for "used up?" Instead of saying "used up," which is not a very elegant expression, there are better words. I do not see any hands up. Well, here is one. Let us write it. EXPENDED. Now, let us repeat the sentence in which this word occurs. All the heat is . . . . *expended*, or . . . . *used up*, in forming . . . . *steam*, which flies off very rapidly as soon as the water . . . . *boils.* As the steam or . . . *vapor*, goes off, it carries with it a great quantity of . . . . *heat.* Lizzie, repeat that . . . . *All the heat is expended in forming steam, which flies off very rapidly as soon as the water boils. As the vapor goes off, it carries with it much heat.* Now for another term for "flies off" or "goes off." Harry . . . . *Escapes.* The steam is said to . . . . *escape.* Mary, you may repeat that statement and use this word. (She repeats.) We said that all the heat, after the water . . . . *boils*, is . . . . . *expended*, in . . . . *forming steam.* I want also another word for forming. Willie? . . . . . *Making.* Julia? . . . . *Producing.* This is the one we will use. After the water . . . .

boils, all the . . . . *heat is expended*, in . . . . *producing steam*, or . . . . *vapor.*

Now the pressure of the atmosphere at the earth's . . . . *surface*, is . . . . 15 *pounds on every square inch*; and as we ascend, the air becomes much . . . . *rarer*, and consequently the pressure is much . . . . . *less.* I will tell you that it becomes so much less at the height of about three miles, that water begins to boil long before it reaches the temperature of two hundred and twelve degrees. The pressure of the steam, as it tries to escape from the . . . . *water*, has less of the pressure of the . . . . *air*, to overcome, so that "boiling," or the escape of the . . . . . *steam*, commences rapidly before the water becomes very . . . . *hot.* A French philosopher named Gay Lusac, in performing the ascent of a mountain in France, took, among other things, some eggs and potatoes for provisions. But when they tried to boil them after reaching the summit, they failed; the water "boiled" long before it became hot enough to cook the eggs or . . . . *potatoes.* Why, James? . . . . *Because the air has so little pressure at that height.* And, consequently, the steam can force itself out in bubbles, and cause the water to . . . . *boil*, before it gets very . . . . *hot.* And as soon as the water . . . . *boils*, it cannot then be made any . . . . *hotter.* What, then, becomes of the heat? Fannie? . . . . *It is used up, or expended, in forming or producing vapor.* The process of producing . . . . *vapor*, from . . . . *water*, is called . . . . *evaporation.*

Now quickly. Heat causes water to . . . . . *evaporate.* The water gradually becomes . . . . *hotter*, till it reaches the temperature of . . . . 212 *degrees*, when it begins to . . . . *boil*, and can be made no . . . . *hotter*, no matter how long we keep it . . . . *on the fire.* All the heat, after it . . . . *boils*, is . . . . *expended*, in . . . . *producing vapor*, and is carried off, or . . . . *escapes*, in the . . . . . *vapor.* The pressure of the air prevents its . . . . *boiling*, until its temperature is . . . . 212 *degrees.* But if carried some three miles above the earth's . . . . *surface*, water will . . . . *boil*, long before reaching . . . . 212 *degrees.* This is because in the upper . . . . *regions*, there is too little . . . . *pressure*, to prevent the escape of the . . . . *steam*, before the water becomes . . . . *hot.*

LESSON XXIV.

ASTRONOMY: THE SOLAR SYSTEM.

Boys and girls who wish to improve are always very diligent, and give their best . . . . . *attention*, during the progress of a lesson. Then all sit . . . . *upright*, and . . . . *attend.*

You all know from our former lessons that the earth's form is . . . . . *round like a ball*, or . . . . *globular*, or . . . . . *spherical.* You also know what its motions are. It has . . . . *two motions;* 1st, ... *the revolutionary motion*, and 2d, ... *the rotatory motion.* Now I wish you to tell me about the revolutionary motion. (See Lesson VII.) Lizzie? . . . . *Its revolutionary motion is performed round the sun once in each year.* The earth, then, revolves round the . . . . *sun.*

Raise hands all who can tell me whether there is any other world besides ours that revolves round the sun. Willie? . . . . *The moon.* Well, the moon, I must explain to you, revolves round the earth while it revolves round the sun. Is there any other world revolving round the sun as the earth does? I will tell you. There are many others. We are to speak of some of them in our lesson to-day. (You may state that there are "many" planets, because the asteroids between Mars and Jupiter, which number over one hundred, are separate planets, and revolve independently round the sun.)

Do you think the earth is the nearest world to the sun? Before I call on those who have their hands up, we will find a word to use instead of "worlds." Ours is called "the earth" or "the world" to distinguish it from . . . . . *the rest.* What word is used for them all? I will tell you. PLANETS. I will write it on the blackboard. All answer . . . . *Planets.* If you go out on a clear, bright night, and look up at the stars carefully, you will see a few that are shining with a clear, steady light, while all the others around them twinkle or flicker. James, repeat that. (He repeats.) Now those that do not . . . . *twinkle*, are planets, that is, they revolve round . . . . *the sun*, as our . . . . *earth does.* Now you may raise hands for my other question. Is there any other planet nearer to the sun than the earth? Sam? .... *No, sir.* Here is a boy who is merely guessing. Annie? .... *Yes, sir.* How many? .... *Four.* Here is a girl who is only .... *guessing.* Now in such a question as this it only wastes our time to raise hands unless you know. George? .... *There are two planets nearer to the sun than the earth.* That is correct. Do you know what their names are, George? .... *No, sir.* Does any one? I see no hands up. Well, all look this way. I will write the name of the first one on our blackboard. MERCURY. I must tell you how it got this name. Some of the ancients did not know about God as we do; they had a great many .... *gods.* Now these gods, they believed, kept one god as a messenger. In carrying the .... *messages,* of the .... *gods,* you think he would have to move very ..... *quickly.* They called his name MERCURY. (Have a representation on the blackboard, and point to each as they answer; only putting down one at a time—the sun first in the centre.) And because this .... *planet,* is nearest to the .... *sun,* it is attracted so strongly by ..... *the sun,* that it is caused to revolve the most rapidly of all the .... *planets.* Hence it was called .... *Mercury.* It is the swiftest of all the .... *planets.* Mercury is nearer to the sun than.... *the earth.*

Well, what is the next planet in order from the sun? We will place its name upon the board. VENUS. This was the name of another of the gods of the ancients. Venus was a goddess. She was the goddess of beauty. And Venus, which is the bright star we sometimes see early in the evening, is so beautiful that it gets the name of this .... *goddess.* Mercury is the .... *first planet,* in order, and it gets its .... *name,* because it revolves .... *so swiftly.* It is called after the god .... *Mercury,* who acted as .... *messenger for the gods.* Next is .... *Venus,* called after the goddess of ..... *beauty,* because it is so ..... *beautiful.* We have now mentioned how many? ..... *Two.* And these are both nearer to .... *the sun,* than..... *the earth.* What are their names? Kate? .... *Mercury and Venus.* And as I said there were only two nearer the .... *sun,* than .... *the earth is,* the next planet in order will be ....

the earth, the earth on which we . . . . *live.* How curious it is to think that our . . . . *earth*, is a great ball revolving round . . . . *the sun*, along with many other . . . . *balls*, or . . . . *worlds*, or, as we called them . . . . *planets.* The earth then is a . . . *planet*, and is the third in order among the . . . . *planets.*

Now, we are not to name any others in this lesson, but you may all investigate this matter before our next lesson. We have, however, some other things to say. Do you know what name is given to the two planets, Mercury and Venus, because they are at a less distance from the sun than the earth? They are called INFERIOR. You may all repeat this word . . . . . *Inferior.* What about inferior? Charlie? . . . . *Mercury and Venus are called inferior planets.* What would your mother mean if she said that she had some very inferior flour? . . . . *She would mean that it was not good.* Now do we mean to say that Mercury and Venus are not worth as much as the other planets . . . . *No, sir.* What, then, does it mean? George? . . . . *We mean that Mercury and Venus are nearer to the sun than the earth.* And they are therefore called . . . . *inferior planets.* What is the opposite of inferior? Let us write it. SUPERIOR. The planets that are more distant from . . . . *the sun*, than . . . . *the earth*, are called . . . . *superior planets.* Ella, repeat that . . . . *The planets that are more distant from the sun than the earth, are called superior planets.* I will tell you their names in another lesson. Is the earth a superior or an inferior planet? Mary? . . . . *Inferior.* Alice? . . . . *Superior.* George, which of them do you consider correct? . . . . *Neither of them.* Why? . . . . *If Mercury and Venus are inferior to the earth, and the others that are farther off are superior, the earth cannot be either.* That answer is very well given. The earth is neither . . . . *inferior*, nor . . . . *superior.*

Now quickly. Our earth revolves . . . . . *round the sun.* So do many other bodies called . . . . *planets.* The planets shine with a steady . . . . *light*, while other stars . . . . *twinkle.* The first in order is . . . . *Mercury*, the second . . . . *Venus*, and third . . . . *the Earth.* Mercury and Venus being nearer to the sun than . . . . *the earth*, are called . . . .

inferior planets, those beyond the earth . . . . *are called superior.*

LESSON XXV.

NATURAL SCIENCE: WIND.

The climate of a country (See lesson on climate—its elements,) we have said, consists of . . . . *three things.* 1st, ... *Temperature;* 2d, ... *Moisture;* 3d, ... *Prevailing Winds.*

What is wind? When the air moves it makes a . . . . . *wind.* Then wind is air in . . . . . *motion.* Libbie, repeat that . . . . . *Wind is air in motion.* And since it does not always blow in the same . . . . *direction*, in most countries, we said prevailing winds, that is those that are most . . . . *common.* But why should the air move at all? Can anything that is not alive move of itself? . . . . *No, sir.* Then what moves the air? We will try and find out.

In our lesson on heat we said that one of its . . . . *effects*, is to cause the substance that is heated to grow . . . . *larger*, or . . . . . *expand.* (See Lesson v.) Now the heat of the sun's rays passes through the air without heating it, but the ground becomes heated, and heats the particles of air along the earth's . . . . *surface.* And what effect did you tell me heat would have on any substance? . . . . *It expands it.* And so it will expand the . . . . *air*, or make it become . . . . *larger.*

Now, if we were to take a gallon of cold air and heat it, it would . . . . *expand*, or . . . . *become larger.* Then would it all remain in the gallon measure? . . . . *No, sir.* Part of it would flow out of it. Would that which remained in weigh as much as the gallon full of cold air? . . . . *No, sir.* Then it would be . . . . ? If it did not weigh as much, it would be . . . . *lighter.*

We will revise a little. The sun's heat does not . . . . . *heat the air as it passes through it*, but it heats . . . . . *the* *ground.* This heats the particles of . . . . *air*, that . . . . *lie on its surface.* The heat has what effect on them ? . . . . *It expands them.* It expands the air, or makes it . . . . . *grow larger.* And as it expands it becomes . . . . . *lighter.* Now when we place a piece of wood under the surface of water, does it remain there ? . . . . *No, sir.* It . . . . *floats.* Why ? . . . . *It is lighter than the water.* And therefore it rises through the . . . . . *water*, and comes to . . . . *the surface.* Now, what would the light, hot air do ? Have you ever seen the motion of the air round a hot stove-pipe ? I want to see all who OBSERVE the little things they see every day. James, what do you think the hot air would do ? . . . . *It would rise.* That is correct, it would rise, just as the wood rises in . . . . *water.* And so the smoke . . . . *rises*, because it is . . . . *hot*, and therefore much . . . . . *lighter*, than the surrounding . . . . *air.* Hot flames also . . . . *rise.* Can you not give me a better word than rise ? All think. Hands up. Emma ? . . . . *Ascend.* Right, and so you conclude that after the air becomes . . . . . *hot*, and therefore very . . . . *light*, it will . . . . . *ascend.* George, repeat that . . . . *When the air becomes hot and expanded and light, it will ascend.* And if there is nothing remaining in the place it has left, what will happen ? Suppose I take a board and move it rapidly through the water, does the space remain long empty ? . . . . . *No, sir.* The water you think rushes . . . . *in*, and . . . . *fills it up.* Now if the air gets hot and light, and ascends or . . . . *goes up*, or . . . . *rises*, what would you expect then to take place ? . . . . *The surrounding air would rush in and fill up the space.* Very good. And this rushing in of the air is what we call . . . . *wind.* Who will now state this cause of wind ? Annie ? . . . . . *When the air gets heated and light, it rises or ascends, and the surrounding air rushes in to supply its place, and forms a wind.* Raise hands all who will state this. Charlie ? (He repeats it.)

In this country the wind does not always blow in the same . . . . . *direction.* This kind of wind is called . . . . ? It is called VARIABLE ; that means changeable. These winds are called . . . . *variable*, or . . . . *changeable*, because they blow in different . . . . *directions.* But there are places where the wind always blows in the same direction. I will tell you why in another lesson.

There are other causes of wind besides what we have stated. But this is the principal cause. Now all answer rapidly. When the air at the earth's .... *surface*, becomes .... *heated*, it .... *expands*, or grows .... *larger*. It thus becomes *lighter*, and like wood and water .... *ascends*, or .... *rises*. The surrounding .... *air*, then .... *rushes in*, to supply its .... *place*. This is what we call a .... *wind*. Then wind is simply .... *air in motion*.

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LESSON XXVI.

PHYSIOLOGY: RESPIRATION.

I wish to see every eye fixed on me. Our lesson to-day is upon the breathing of animals. The word which is generally used is .....? I will write it. RESPIRATION. This is another word, Mary, instead of ..... *breathing*. Charlie, what term is used instead of breathing? ..... *Respiration*.

There are two processes that require to be continued constantly, in order to support the life of an animal. These are EATING and BREATHING. By the first the body is supplied with .... *food;* and by the second it is furnished with .... *air*. Deprive an animal of either .... *food or air*, and it will .... *die*. Both of these processes are necessary to support its .... *life*. If we value them according to the time that either process may be interrupted, the most important will be .... *breathing*, for we can live some days without .... *food*.

What are the organs of respiration? (See Lesson IV.) Hands up. Fannie? .... *The lungs are the organs of respiration.* We continually breathe the ..... *air*, into our .... *lungs*. There is one word which means to breathe in, and another which means to breathe out. What are they?

I will show you. The Latin word SPIRO means TO BREATHE; and the prefix IN means INTO. EX also means OUT. Now if we use the root (See Lesson XIII.) SPIRE, and place the prefix IN before it, we have the word . . . . . *inspire*, which will mean . . . . *to breathe in*. Now, as you told me the word for "breathe in," you can doubtless tell me the word for "breathe out." It is . . . . *expire*. Yes. We inspire and . . . . *expire;* that is, we . . . . *breathe in and breathe out again*. Willie, you may repeat that. (He does so.)

You already know that the air contains two . . . . . *gases*, which are . . . . *oxygen and nitrogen*. How much is oxygen? . . . . . *One-fifth*. The other four-fifths is . . . . . *nitrogen*. (See Lesson XI.) The nitrogen is only for the purpose of . . . . *diluting the oxygen;* the oxygen, then, is the most . . . . *important*, because without it, fire could not . . . . *burn*, nor could animals . . . . *live*. We are now about to inquire how this is.

The blood, as it circulates through the . . . . . *body*, on leaving the right ventricle of . . . . *the heart*, passes to . . . . *the lungs*. (Explained in Lesson XXII.) Here it is exposed in very minute cells to . . . . ? What do we breathe into our lungs? . . . . *Air*. We inspire or . . . . *breathe in air*. Then, in the lungs the blood is exposed to the . . . . *air*, that is supplied by the process of . . . . *breathing*. What happens at this time? Why do you think oxygen is the most important gas? I will tell you. The blood, while in the lungs, TAKES UP THE OXYGEN of the air that is . . . . *inspired*. Can you give me a better term than "takes up?" A sponge takes up water. But we might say, George, that it . . . . *absorbs water*. Very good. That is the word. And the blood . . . . *absorbs the oxygen*, while in . . . . *the lungs*.

Well, we inspire or . . . . *breathe in*, both oxygen and . . . . *nitrogen*. Now, can any one tell me what we expire? that is, what we . . . . *breathe out*. Hands up. Emily? . . . . *We expire only the nitrogen*. Does any one think we expire anything else besides nitrogen alone? You can tell better when we have advanced further with our lesson.

You have told me that in the . . . . *lungs*, the blood absorbs or . . . . *takes up*, the . . . . *oxygen*, of . . . . *the air*, that we .... *inspire.* It then flows back to the ..... *heart.* From the heart it is sent through .... *the arteries*, to all parts of .... *the body.* Now listen carefully while I impart to you another secret. The blood flows bright and crimson from the arteries into the small .... *capillary vessels.* It is bright because of the oxygen that it .... *contains.* But as it passes through the capillary vessels, the oxygen is all used [illegible] by uniting or combining with the worn-out parts of the body. It combines or .... *unites*, with two substances in particular. These are CARBON and HYDROGEN. You will hear more about them afterwards. When the oxygen combines with carbon it forms another kind of gas, called CARBONIC ACID GAS; and when it combines with hydrogen, it forms the water that comes out as vapor in our .... *breath.* Then, as the blood travels on through the veins it is not bright and crimson as it was in .... *the arteries*, but it is of a dark, bluish-red color. It now has in it, instead of the .... *oxygen*, the water of which I spoke, and also the carbonic acid. And when it is sent again to the lungs by .... *the heart*, it gives up both of these .... *substances*, and they pass out in the .... *breath.*

Now I will ask some questions. First, the one I asked a few minutes ago. Who can tell me what we breathe out? Or, what we .... *expire?* I see nearly every hand up now. I can plainly see who have been attentive. George? .... *We expire nitrogen, carbonic acid gas, and vapor.* That answer is perfectly correct. Who can repeat it? All who cannot, will remain and write it ten times on their slates. I will get some small boy to dictate it to them. What happens to the blood in the lungs? Hands up. Sam? .... *It absorbs oxygen.* What gas is in the blood in the arteries? Kate? .... *Oxygen is contained by the blood in the arteries.* What does the oxygen combine with in the capillary vessels? Bessie? .... *Carbon and hydrogen.* And what two substances are formed as they unite? Fred? .... *Carbonic acid gas, and water.* Annie, you may tell me what gases we inspire and what we expire .... *We inspire, or breathe in, oxygen and nitrogen, and we expire, or breathe out, nitrogen, carbonic acid gas and vapor.* I will tell you that a very little of the oxygen also comes out again. But it is only that which was not taken up, or ..... *absorbed*, by ..... *the blood.*

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LESSON XXVII.

NATURAL SCIENCE: TRANSMISSION OF HEAT.

I am glad that all our scholars give such good ..... *attention*, during our Oral .... *Lesson*, for I am always satisfied when scholars attend that they will surely .... *learn.*

Raise hands all who will give me the sources of heat. (See Lesson XIV.) Emily? .... *1st, The Sun; 2d, Combustion; 3d, Friction; 4th, Percussion; 5th, Chemical Action; 6th, Electricity.* By the sources of .... *heat*, we mean .... *where heat is obtained*, or .... *derived.* Well, to-day we are to speak of the way in which heat passes from one object .... *to another.* And first let us speak of the way in which the sun's heat passes to .... *the earth.* How does it pass? In what way? When you partly close your eyes and look at a lamp with a bright flame you see the light passing off from it in .... *streaks.* (Some such word will be given here.) Can you not give me a better word than streaks? Willie? .... *Lines.* That word would do, but there is a better one. It is RAYS. The light of the lamp goes off in RAYS. Or, we might say that the lamp sends forth ..... *rays of light;* instead of "sends forth" we will use a word that we have once before used. The lamp sends forth or .... *emits light.* It emits the light in .... *rays.* The light is then said to .... ? It is said to RADIATE. Let me hear every one pronounce it distinctly .... *Radiate.* Now does anything else pass off or radiate from the lamp besides the light? ..... *Yes, sir; the heat radiates also.* The heat, you say .... *radiates*, that is, it passes off in .... *rays.* And this is the way in which the heat comes to us from the sun. It .... *radiates*, from .... *the sun*, to ..... *the earth;* that is, it passes over in .... *rays*, or straight .... *lines.* Annie, repeat this .... *The heat radi-*

ates from the sun to the earth; that is, it passes to it in straight lines called rays. Charlie, what else besides heat goes off in similar rays? .... *Light.* What about it? .... *Light radiates as heat does.* This way is called RADIATION. Heat comes to .... *the earth,* from .... *the sun,* by .... *radiation.* This is one way in which heat is .... *sent.* Another word for "sent." Here is the one I wish you to use. TRANSMITTED. This word consists of two parts. The part, "trans," means across; and the second part, "mitted," means sent. What will transmitted mean? Eliza? .... *Sent across.* Yes. If I tell you one hundred messages were transmitted over the telegraph lines in one day, what would I mean? Peter? ..... *You would mean that the messages were "sent across" the country.* And if we say that heat is .... *transmitted,* from the ..... *sun,* to ..... *the earth,* we mean that it .... *is sent across.* One way, then, in which it is transmitted is by ..... *radiation,* that is, passing over in .... *rays.*

Does heat travel or pass in any other way? If you take a common pin, and try to loosen the wick of a burning candle with it, you very soon have to loosen your hold of the .... *pin.* Why? Is it because the heat radiates to your fingers .... *Yes, sir.* Now let us see. Can you hold your hand at the same distance from the candle without the pin? .... *Yes, sir.* Then why does the heat not now radiate, while it did so when you held the pin? George? .... *It does not radiate in that case. I think the pin has something to do with it.* Yes, I think it has. Let us inquire how it happens. The pin is composed of a..... *metal.* When the particles of the pin that are in the flame become .... *hot,* they give the heat to their neighbors that lie alongside them. Do they move themselves? .... *No, sir.* They do not move, but they LEAD the heat along from one to .... *another.* Can you give me a word for "lead?" Mary? .... *Carry.* Now, just think. Could they CARRY the heat, if they do not themselves move? .... *No, sir.* Then "carry" is not the word that we .... *wanted.* Let me write it. CONDUCT. The particles of metal .... *conduct the heat,* or ..... *lead it,* from one to ..... *another.* This is another ..... *way,* in which heat is .... *transmitted,* or . . . . *sent across.* This second way is called CONDUCTION, because the heat is . . . . *conducted.* Frank, repeat that. (He repeats.) Susan, you may give these two ways of transmitting heat. (She does so.)

There is still another way. How is the air in a room heated? or the water in a boiler? Let us investigate this method of transmitting . . . . *heat.* When rays of heat pass through the air they do not have any perceptible effect in heating it. It has a certain name on this account. It is called DIATHERMANOUS. This word means that it allows the heat to pass through it without becoming heated. The air again, is . . . . *diathermanous,* because it allows the heat to . . . . *pass through it.* And since the rays of heat pass through it, they do not . . . . *heat it.* But they heat the ground, and the ground heats the particles of . . . . *air,* that lie . . . . *close to it,* by the last way we named . . . . *conduction.* Then the warm particles begin to MOVE among the . . . . *colder ones,* and this causes others to get . . . . *warm.* When they become warm they also . . . . *move,* among the . . . . *colder ones,* and thus the heat is . . . . *carried,* about. The word used to represent this way of transmitting . . . . *heat,* is CONVECTION. Convection means CARRYING, while conduction means . . . . *leading.* In the last way, that is . . . . *convection,* the particles themselves . . . . *move,* and thus carry the . . . . *heat.*

Well, there are then three methods in which heat is . . . . *transmitted.* They are, 1st, ... *radiation,* by which we mean that the heat travels in . . . . *straight,* lines called . . . . *rays;* 2d, ... *conduction,* in which the heat is . . . . *conducted,* or . . . . *lead,* from one particle to . . . . *another,* while the particles themselves do not . . . . *move;* and 3d, ... *convection,* or the . . . . *carrying,* of the . . . . *heat,* by the moving of the . . . . *particles.* This can only take place in liquids or . . . . *gases,* where the particles can move . . . . *freely,* or . . . . *readily,* or . . . . *easily.* All repeat the three ways again. First, we have . . . . *radiation;* 2d, ... *conduction;* 3d, ... *convection.*

LESSON XXVIII.

ASTRONOMY: THE SOLAR SYSTEM.

We are to continue our former lesson on THE SOLAR SYSTEM to-day. (See Lesson XXIV.) You will all require to give your best . . . . *attention*, for without this you cannot . . . . *learn*.

The planet which is nearest to the sun is . . . . *Mercury*. This is the swiftest of the . . . . *planets*, and is named after the messenger of . . . . *the gods*. Next comes . . . . *Venus*, which was called after the beautiful goddess . . . . *Venus*, because it is so . . . . *beautiful*. These two . . . . *planets*, are called . . . . ? Because they are at a less distance from the sun than . . . . *the earth*, they are called . . . . *inferior planets*, which means that they are at an inferior . . . . . *distance*. Then we find, next in order . . . . *the earth*, and beyond it are those . . . . *planets*, that are called . . . . *superior*.

I did not tell you the distance of Mercury and Venus from the sun; and, indeed, it would be too much to remember any but that of the earth. Does any one know how far the earth is from the sun? IT IS NINETY-FIVE MILLIONS OF MILES. What is, Alice? . . . . *The earth is ninety-five millions of miles distant from the sun*.

Now we will commence with the superior . . . . *planets*. The next in order after . . . . *the earth*, is MARS. Let me hear this name from all . . . . . *Mars*. This is the fourth . . . . . *planet*. Robbie, will you now name all four? . . . . *Mercury, Venus, The Earth, Mars*. Mars was named after the god of War. Who was the god of War, Sam? . . . . *Mars was the god of War*. And the fourth . . . . *planet*, in order from . . . . *the sun*, was named after this god. It was called . . . . *Mars*.

Then we find the largest of all the . . . . *planets*. It is named after the king of all the gods. The king of the gods was . . . . ? Let me write it. JUPITER. His name was . . . . *Jupiter*, and this was the name of this . . . . *planet*. Mars was the fourth, and so Jupiter is . . . . *the fifth*. Allie, you may tell me the fourth and fifth planets . . . . *The fourth* *planet is Mars and the fifth Jupiter.* The last one named was called after .... *the king of the gods*, on account of its .... *size.* Jupiter is the largest of all ..... *the planets.* Repeat that, Frank. (He repeats.)

Next we find SATURN. It was named after another .... *god.* You will remember it when I tell you of its rings. (To illustrate this, place a small finger-ring inside a larger one, and inside the inner one a pea, or any small round object. The wire of the ring should be square instead of round. A couple of such rings cut from a potato would be better. First cut a flat slice, then cut two rings from it, one a little smaller than the other, so as not to come in contact with it.) It is surrounded by two solid rings of matter which do not touch it or each other. These are called SATURN'S RINGS. Now you may all answer; this planet .... *Saturn*, is surrounded by .... *two rings*, of solid .... *matter*, which do not .... *touch it.* They are called .... *Saturn's rings.* How many did we name before Saturn? .... *Five.* Then it is the .... *sixth.* 1st, we have .... *Mercury;* 2d, ... *Venus;* 3d, ... *The Earth;* 4th, ... *Mars;* 5th, ... *Jupiter;* and 6th, ... *Saturn*, which is surrounded by .... *two rings.*

The seventh is called after its discoverer. Its name is HERSCHEL. The name of this planet, then, is .... *Herschel.* This was the name of the astronomer who .... *discovered it.* It also has two other names, but it will only burden your memories to ask you to remember them. I will, however, state them. One is GEORGIUM SIDUS, which means "George's Star;" and the other is URANUS. But we will use the name .... *Herschel.*

The last is also named after its .... *discoverer.* It is called LEVERRIER. It also has another name, which will perhaps be more easily remembered. It is also called NEPTUNE. This was another god's name. It is the last .... *planet.* Its name again is NEPTUNE. Now give them all, pausing between each one .... *Mercury; Venus; The Earth; Mars; Jupiter; Saturn; Herschel and Neptune.* How many? ..... *Eight.* George, repeat their names. (He does so.) Raise hands all who will do so. I see two whose hands are not raised. Fannie, you and Richard will spend a few moments with me at recess in writing their names till you can repeat them.

All may now answer again as we review. Revolving round the . . . . *Sun,* there are . . . . *eight planets.* The first two, which are . . . . *Mercury and Venus,* are called . . . . *inferior.* Next is . . . . *the Earth.* Outside of it are those that are called . . . . *superior.* There are how many superior planets? . . . . *Five.* They are . . . . . *Mars, Jupiter, Saturn, Herschel and Neptune.* Saturn is surrounded by . . . . *two solid rings.* These eight . . . . *planets,* all revolve round . . . . *the sun.*

LESSON XXIX.

NATURAL SCIENCE—LIGHT: ITS NATURE AND SOURCES.

To-day our lesson is upon LIGHT. Light is that by means of which we . . . . *see.* Again, we see by means of . . . . *light.*

What is light? Is it anything? Do you think it has any weight? Well, Annie? . . . . *I think it must have weight.* Well, it is very natural to suppose so. But let us look at some facts. It has been discovered—I will tell you how in some other lesson—that the light travels at the rate of about twelve million miles in a minute. Well, Sam? . . . . *How can they know that?* I said I would explain how it was . . . . *found out,* in another . . . . *lesson.* You must take my word for it now. For what, Willie? . . . *For the fact that light travels at the rate of twelve million miles a minute.* Now you all know that if the smallest kind of shot are thrown from a . . . . *gun,* at the rate of perhaps two hundred yards in a second, they go with a great . . . . *force.* Do you think, Annie, that shot, however small, moving so rapidly, would do any injury to our eyes, or the delicate leaves of a flower? . . . . *Yes, sir; it would destroy them.* Now, in the next place, if the particles of light have any weight whatever, coming at the rate of . . . . . 12,000,000 *miles a minute*, they would utterly destroy our . . . . *eyes*, or any other very delicate . . . . ? Anything that is made or constructed, either by man or God, may be called . . . . ? I will write the word. STRUCTURE. All answer . . . . *Structure.* You think that any delicate . . . . *structure*, such as our . . . . *eyes*, or the leaves of . . . . *flowers*, or the tender wings of butterflies and other . . . . *insects*, would be . . . . *destroyed*, if the particles of the . . . . *light*, have any . . . . *weight.* For this and other good reasons philosophers believe that light has no . . . . *weight.*

Does any other boy or girl remember any other body in nature that has no weight? What else comes from the sun besides light? . . . . *Heat.* Yes. Light and heat are both bodies that are supposed to have . . . . *no weight.* There is a word which means "having no weight," or "not able to be weighed." What is it? Hands up. Perhaps you have never heard it before. Let us place it on our blackboard. IMPONDERABLE. Light and heat are both said to be . . . . *imponderable*, that is, they have . . . . *no weight.* Can you think of any other imponderable body? Only three are known to exist. What is the other one? What is it that passes so rapidly over the telegraph lines? . . . . *Electricity.* That is the other one. Who will name the three? Ella? . . . . *Light, Heat and Electricity are the three imponderable bodies.* Very well.

Now I wish to ask another question. Whence do we get light? Hands up. Frank? . . . . *From the sun.* Lizzie? . . . . *From lamps.* Allie? . . . . *From candles.* Mary? . . . . *From fire of every kind.* Well, who can remember one word for "fire of every kind?" In enumerating the sources of heat, we said that one source was fire, or . . . . *combustion.* (If it is not answered, write it again on the board.) I only heard two voices give this answer. Again . . . . *Combustion.* We have now named two sources from which we get . . . . *light.* They are, 1st, ... *The Sun*, and 2d, ... *Combustion.* These, again, are two . . . . *sources of light.* Is there any other? Has any one ever seen a very brilliant flash of light come from the sky? When did you see it, Sam? . . . . *During a thunder-storm.* Where did it come from?

. . . . . *It came from the clouds.* Yes, but what caused it? . . . . . *The thunder.* Well, the thunder was a sound that accompanied it. But do you know what caused both the thunder and the flash? I will tell you. It was that third imponderable body that we mentioned. Hands up those who remember it. Charlie? . . . . . *Electricity.* That is another source of . . . . *light.* Whenever electricity is discharged—and you will know better what I mean by this after we advance further—it causes a flash of . . . . *light,* and is therefore a . . . . *source of heat.*

Let us now rapidly revise. We conclude that light has no . . . . *weight.* It cannot be . . . . *weighed.* There are also two other . . . . *bodies,* or . . . . *substances,* in Nature that cannot be . . . . *weighed.* They are . . . . *heat and electricity.* These three are therefore called the three . . . . *imponderable bodies.* The imponderable bodies again are, 1st, ... *Light;* 2d, ... *Heat;* and 3d, ... *Electricity.* Light is derived from three . . . . *sources.* 1st, ... *The Sun;* 2d, ... *Combustion;* and 3d, ... *Electricity.* I may state that combustion is only one form of chemical action, and that other kinds of chemical action produce . . . . *light.*

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LESSON XXX.

NATURAL SCIENCE : SOUND.

You formerly told me in one of our lessons (See Lesson VIII.) that we become acquainted with what surrounds us by means of what we called the five . . . . *senses.* These are, 1st, ... *Seeing;* 2d, ... *Hearing;* 3d, ... *Feeling;* 4th, ... *Smelling;* and 5th, ... *Tasting.* The second sense, which is . . . . . *hearing,* is the one by which we perceive . . . . *sounds.* Again, sounds are . . . . *perceived,* by the sense of . . . . *hearing.*

Now I wish to ask you what else is necessary in order to hear besides the ears? Well, you can answer better after our lesson is over.

When I strike this .... *desk*, (or whatever you strike, suiting the action to the word,) you hear a .... *sound*; and when a bell rings you also hear .... *a sound*. Now what is sound? It is not many years ago since people imagined that whenever a bell was rung, small particles of metal were struck off and flew rapidly and entered .... *the ear* (pointing to the ear), thus causing what we call a .... *sound*. But there were a great many objections to this theory. It could not be explained how the sound was made when the wind whistled round a corner. And it was soon proved that sound was caused in quite a different .... *way*.

We proved not long ago (See Lesson IX.) that air really is a .... *substance*, since it weighs something, or, in other words, has .... *weight*. I wish to have you remember this as we will refer again to it in a few moments. Has any boy or girl ever seen a child place the blade of a knife in a crack in the table and then strike the handle, and cause it to make a rattling sound? Well, Eddie? .... *I had my ears "boxed" for doing it once.* Well, you all know what I mean. The knife-handle flies backwards and .... *forwards*, very .... *rapidly*. I now want a word which means to go back and forth in that manner. How many know of such a word? Mary? .... *Shiver*. Ella? .... *Tremble*. Frank? .... *Rattle*. Frank, if you stretch a string tight and cause it to do so, would you say it rattled? .... *No, sir.* No, but it would tremble or .... ? What other word do you know besides tremble, shake and shiver? I will write the word I want. VIBRATE. All pronounce it together .... *Vibrate*. The blow you strike causes the knife to .... *vibrate*, or move very .... *rapidly*, back and .... *forth*. And you remember that you have just said that the air is a real .... *substance*. Now if the desk moves or .... *vibrates*, it strikes every time against .... ? What surrounds it everywhere? .... *Air*. Well, it would strike then against ..... *the air*, and this would cause the air also to .... *vibrate*.

Let us see whether we can find a good way to represent this vibration of the air. Has any one ever seen a stone dropped into smooth water? Sam? .... *I have often thrown* *one in.* Well, did you ever notice, Sam, what happened to the surface of the water when the stone dropped? .... *Yes, sir; the stone made small waves on the surface of the water.* Who will repeat that? Fred? .... *A stone dropped in a pond of water causes small waves on the surface of the water.* And these waves roll on till they reach the edge of the .... *water.* Well, I will tell you that those waves on the .... *water,* are just like the little waves that are caused in the .... *air,* when anything .... *vibrates.* And when they enter our .... *ears,* they cause us to hear .... *a sound,* by operating on the nerves of our .... *ears.*

If I strike a great rock, how does it sound? Would it sound as plainly as when I strike this box? .... *No, sir.* Why? Who can answer this? All ought, if all were listening. Well, George? .... *It does not vibrate so much, being so solid, and therefore it does not cause so many waves in the air, and consequently we cannot hear it as plainly.* If I strike a sheet of tin or iron, this causes much .... *noise.* Why? Allie? .... *Because it vibrates so easily, and causes so many waves in the air.*

These waves roll off in every .... *direction.* It sometimes happens that the sound-waves strike against the side of a large building, a high bank or bluff, or the edge of the woods. When this happens what do you think becomes of the waves? Did you ever hear an echo? .... *Yes, sir.* What is an echo? Kate? .... *It is a sound heard after another, without any apparent cause.* Now, from what we have said, can you not guess what becomes of the sound-waves when they strike the side of a building? Henry? .... *They come rolling back to our ears again.* Very good; and you think this is what causes an .... *echo.* Raise hands all who can now tell me what causes an echo? Eva? .... *An echo is caused by the sound-waves rolling back after striking some large object.*

Before our lesson closes I want another word for waves. The one I want comes from the Latin word UNDA, a wave. It is UNDULATIONS. The waves on the surface of .... *water,* might be called .... *undulations.* What is meant when men speak of an undulating country or an undulating prairie? George? .... *They mean that it is waving, or not* *perfectly level; or has hills and hollows.* And these waves in the air are called . . . . . *undulations.* I want all to remember this word till we have the next lesson on Light, as we will then use it again.

Sounds are produced in the . . . . . *air.* When anything is caused to shake rapidly or . . . . . *vibrate,* since it moves against the . . . . . *air,* it causes it also to . . . . . *vibrate.* When it vibrates it contains a great many small . . . . *waves,* such as we see on the surface of . . . . *water,* when we throw in . . . . *a stone.* These waves entering . . . . *the ear,* affect a nerve which causes us to . . . . *hear a sound.* The sound, then, is simply the vibrating of . . . . *the air.* When these waves strike against a large . . . . *object,* like a . . . . *house,* they roll . . . . *back,* and cause . . . . *an echo.* Instead of "waves" we use another word, which is . . . . *undulations.*

LESSON XXXI.

ETYMOLOGY—DERIVATION: WORDS FROM PLICO.

We are to have another exercise to-day in examining the process by which English words are derived from the LATIN language.

In one of our lessons on this subject (See Lesson XIII.) we said that a Latin word from which we derive words is called . . . . *a root.* The root that we will select for to-day is PLICO, PLICATUM; to fold. The words will all contain either "PLI," "PLY," or "PLICATE," and will all have some allusion to folding.

Those who can give me a word may raise hands. Well, Minnie? . . . . *Multiply.* That is a good word. MULTUS means MANY; and since ply means . . . . *to fold,* to multiply will mean . . . . *to fold many times.* Thus twelve has, as it were, four folded . . . . *three times;* and seventy-five has twenty-five . . . . *folded three times;* very much in the same way that cloth is . . . . *folded.* This process is called . . . . *multiplication.* This is another word.

Now I will ask again. Fred? . . . . . *Reply.* . Very well. The syllable RE (See Lesson XIII.) means . . . . . *back;* to reply, then means to . . . . *fold back.* It is applied to conversation. The first person makes a statement, and the other . . . . *replies*, or folds his statement back upon his neighbor's; he, in his turn, makes another reply or . . . . . *fold*, and thus it is folded over and over again, by their continual . . . . *replies.*

Will some one give us another word? Raise hands all who can. Genie? . . . . *Pliable.* That is a good example. You would say that cloth, or paper, or leather is . . . . *pliable*, or able to be . . . . *folded.*

We are ready for more words. Frank? . . . . *Complicated.* Yes. CON means . . . . *together*, and therefore complicated will mean . . . . ? If "plicated" means folded, and CON together, what will be meant by complicated? . . . . *Folded together.* Thus when we look at a locomotive or a watch, we call it a very . . . . *complicated*, piece of . . . . *mechanism*, because it appears to be so much folded . . . . *together.* When a question in arithmetic or algebra is composed of a great many parts, it is also said to be . . . . *complicated*, or . . . . *folded together.*

Now you may raise hands for others. Give yours, Ella . . . . *Imply.* Right. And since IM means IN, and PLY, to fold, to imply will be . . . . *to fold in.* If I say, "The second house that was burned contained much furniture," you instantly conclude, although I did not state it, that another . . . . *house had been burned before it.* And you are said to imply this; that is, you fold this idea in with . . . . *the other.*

What is your word, George? . . . . *Implicated.* When a man is guilty of a crime and it is proved that some other person was also guilty with him, the second would be said to be . . . . *implicated.* People become implicated in crime.

We would now like to hear others. What word have you, Charlie? . . . . *Triple.* TRI means THREE, and so triple means having . . . . *three folds.* The word which means having two folds is . . . . *double*, and the word AMPLE means with many . . . . *folds.*

Mary, what is your example? . . . . *Explicit.* When anything is well explained or unfolded, it is said to be . . . . *ex-*

plicit. Ex means . . . . . *out*, and explicit, then, simply means . . . . *folded out.* And so you might easily conclude, implicit would mean . . . . *folded in;* yes, as when we speak of implicit confidence.

Did you ever hear of a word which means "without any folds," or "having no folds?" I will write it under our other words; you will wonder when you see how simple a word it is. It is SIMPLE. SINE means WITHOUT; it is changed to SIM for convenience. The word means, again, ... *without folds.* A lever is a contrivance that is exceedingly . . . . *simple;* much simpler than a steam-engine. In the Bible, simplicity is used for innocence—no folds of guilt. But when we say a person is simple, we mean that his mind has few . . . . *folds*, or is undeveloped.

(Now retrace the lesson and repeat the definitions, calling on each one for a full statement. Have all the words on the board.)

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LESSON XXXII.

DIFFERENCE BETWEEN SCIENCE AND ART.

We have now had a number of lessons upon different . . . . *subjects.* This morning I wish to tell you of something useful in connection wish these subjects. I wish to see every one sitting . . . . *upright*, so as to be able to . . . . *attend.*

You remember our lesson upon the Solar System. We named eight bodies that revolve round . . . . *the sun*, and called them . . . . *planets.* Now, that branch of knowledge which describes or relates to these things, and to all the heavenly bodies, and their motions or distances, etc., is called . . . . ? Do you not know what it is called? It is ASTRONOMY. And astronomy is called . . . . ? This word that we want supplied here is the principal word of our lesson to-day. Perhaps some of you have seen it before. If so, you will at once recognize it when you . . . . *see it.* It is derived from the Latin verb SCIO, I KNOW, and it means all that we can know about anything. George? . . . . *Is it science?* Yes, that is the word. Let us write it on the board. SCIENCE. Astronomy is called a . . . . . *science.* What does a science mean? If you look at the board you see that SCIO means . . . . *I know;* then science will probably mean that which we . . . . *know.* What we know is commonly called knowledge; after it is arranged for the purposes of study, it is termed science. Then you may tell me, Alfred, what a science is . . . . *It is something that we know.* What we know about the stars is the science of . . . . *Astronomy.* Perhaps you would like to know how this word astronomy was formed. I will show you. The Greek word ASTRON means A STAR; and NOMOS, which is also a Greek . . . . *word,* means A LAW. So Astronomy will mean, literally, the laws which govern . . . . *the stars.* And I have just told you that all we know of the heavenly . . . . *bodies,* is included in the science of . . . . *Astronomy.*

Will any one in the room now tell me of another science? Bessie? . . . . . *Geology.* Yes, this is another . . . . *science,* the science of . . . . . *Geology.* It teaches us about the rocks, etc., which form the crust of . . . . *the earth.*

Any other? Wallace? . . . . . *Arithmetic.* Very good. This means the . . . . *science of numbers,* or that which we . . . . *know about numbers.*

Now I will proceed to the second part of our lesson. After we study a science sufficiently, we then begin to do the things which it . . . . *teaches us,* or, to do things depending on what it . . . . *teaches us.* What word, now, is used to indicate anything that we DO instead of anything that we KNOW? Let me write it. Anything that we do is called an ART. Thus, we speak of the ART of making . . . . *cloth* (touching a piece of cloth). Or, the ART of making . . . . *glass* (pointing to the window). Now Arithmetic, besides being a science, is also an . . . . *art,* for it is a way of DOING something. Can any one give me any other art? George? . . . . . *The art of printing.* Very good; that is an art. Any other? Alice? . . . . *The art of teaching.* Very well.

Now I will allow all to raise hands to give me examples of both arts and sciences. Kate? . . . . *Building houses, or Architecture, is a science and an art.* Edward? . . . . *Making* *boots and shoes is an art.* Is it a science also, Edward? . . . . *No, sir.* Jennie? . . . . *Physiology is a science, is it not?* Yes; we have had several lessons in the science of . . . . *Physiology.* (See Lesson IV.) Physiology teaches us not of the organs of our . . . . *bodies,* but of their . . . . *functions;* or that which they . . . . *do.*

Now I want others. Hands up. Frank? . . . . *Is Grammar a science or an art?* Who can tell him this? Emma? . . . . . *It is a science.* Fred? . . . . *It is an art, I think.* Well, you are both correct. Like Arithmetic, it is both a . . . . . *science and an art.* What other science did I tell you of when I spoke of Physiology? That which tells us of the organs themselves is . . . . *Anatomy.* Only three answered then. Well, after seeing the word several times, like a new face, it will become familiar to you; that is, you will then . . . . . *know it.* Anatomy, then, is a . . . . . *science.*

Did you ever hear of the science of MUSIC? . . . . *Yes, sir.* Is it not also an art? Do we not do something? I will tell you. The art is called SINGING, but the science is MUSIC. Repeat that, Ella . . . . *The science is called music, and the art singing.*

Then a science is that which we . . . . *know,* about anything; while an . . . . *art,* is that which we . . . . *do,* that depends on the . . . . *science.*

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LESSON XXXIII.

NATURAL SCIENCE: MECHANICAL PROPERTIES OF THE ATMOSPHERE.

Every eye must be directed this . . . . *way;* then I wish also to see each one sitting . . . . *upright.* This is the best position in which we can sit if we wish to give good . . . . *attention,* and receive the full benefit of the . . . . *lesson.*

In a former lesson (See Lesson VI. and IX.) we spoke of the properties of the air. One was its .... *weight* (making a gesture with the hand as though holding a heavy weight). Raise hands all who can tell me its weight. George? .... *A column of air extending from the earth's surface to the top of the atmosphere, one inch square, weighs fifteen pounds.* That is very well stated. And on account of its .... *weight,* it exerts a great .... *pressure,* on the earth's .... *surface.* This is the second property of air. Although weight and pressure are the same, we will speak of the pressure as a separate .... *property.* You will learn why afterwards. Who will now give the two properties of the air that we have mentioned? Alice? .... *The first property was its weight, and the second its pressure.*

We will now look at some others. Of what color is the air? Raise hands. Fannie? ..... *White.* White like snow? .... *No, sir.* Well, what color then? Is it yellow? .... *No, sir.* Of what color are clouds? The prevailing color is .... *gray.* Is the air of the same color? .... *No, sir.* No, for then we could not distinguish a cloud from .... *the air.* Has air any color? .... *No, sir;* then you would say, if it has no .... *color,* that it is .... *colorless.* And anything like the air, that we cannot .... *see,* having no .... *color,* is said to be ....? In the night we cannot see the sun. Then the sun is not VISIBLE, so it is .... *invisible.* And air is also, then .... *invisible.* I will write this word. Visible would mean able to be .... *seen,* but when we say that anything is ..... *invisible,* we mean it is .... *not able to be seen.* We will call this property INVISIBILITY. The 1st was .... *weight,* the 2d, ... *pressure,* and 3d, ... *invisibility.*

We now come to another property. Does any one remember the first effect of heat that we mentioned? (See Lesson V.) Edward? .... *It causes substances to expand or become larger.* Air has this property. It becomes greatly increased in bulk when heated. That is, it .... *expands.* Air will .... *expand,* when it is .... *heated.* What will you call this property of air? We call it EXPANSIBILITY. This means its power of .... *expanding.* The first property, Kate? .... *Weight;* the second, Willie? ..... *Pres-*

sure; the third, Ella? . . . . . *Invisibility;* and the fourth, Richard? . . . . *Expansibility.*

Now we may search for other properties. Have you ever seen a pop-gun? . . . . *I have.* (Always cause them to raise hands in any such case, and not answer promiscuously. But for the general ellipsis require to all answer simultaneously.) How is it discharged? Eddie? . . . . *A pellet is fastened in one end, and another driven through the tube to force it out.* And does the second pellet press against the first one Eddie? . . . . *I do not know, sir.* Who knows? Frank? . . . . *No, sir; it does not.* Well, Frank, what forces pellet No. 1 out? I will tell you. When pellet No. 2 is put in, there is between the two a quantity of . . . . *air.* And when we force pellet No. 2 through the tube, this air is greatly . . . . ? Cannot some one tell me what happens to it? It is greatly . . . . *squeezed,* or . . . . ? I gave you a better word than this. (See Lesson VI.) Who remembers it? It means PRESSED TOGETHER. George? . . . . . *Compressed.* That is it. The air between the two . . . . *pellets,* becomes greatly . . . . *compressed,* and at last forces the first one . . . . *out.* And since air can be . . . . *compressed,* we say it possesses COMPRESSIBILITY. This is the fifth . . . . *property.* We will repeat them all again. 1st, ... *weight;* 2d, ... *pressure;* 3d, ... *invisibility;* 4th, ... *expansibility,* and 5th, ... *compressibility.*

There is still one other property that we will mention. You have often seen India-rubber. What is there remarkable about it? Charlie? . . . . *It is very elastic.* Very good. You mean by that, that it can regain its former . . . . *shape,* or . . . . *position.* Now I will tell you that the air is far more elastic than India-rubber! When it is compressed in the pop-gun, it at last, in attempting to regain its former . . . . . *position,* forces out the . . . . *pellet.* This property of air is called ELASTICITY.

Now for a rapid recapitulation. The first of the mechanical . . . . *properties* of . . . . *air,* is its . . . . *weight;* 2d, ... *its pressure;* 3d, ... *its invisibility;* 4th, ... *its expansibility;* 5th . . . . *its compressibility,* and 6th, ... *its elasticity.*

LESSON XXXIV.

LUXURIES AND NECESSARIES OF LIFE.

When we commence it is always pleasant to see every eye directed towards your . . . . *teacher*, by which I know that all are giving their best . . . . *attention.*

In order to live we daily use a great many things both in our food and our clothing, and otherwise, which we could do almost as well without. Sometimes, for example, a ring is worn on the . . . . *finger*, or candy or sweetmeats are . . . . *eaten.* But if we were altogether deprived of these things, we could probably live just as . . . . *well*, and be equally comfortable.

Now will any boy or girl tell me a name that is given to all such articles? Things that we could just as conveniently do . . . . *without*, are called . . . . ? Look this way as I write it on the blackboard. LUXURIES. They are called . . . . *luxuries.* What are luxuries? Mary? . . . . . *Luxuries are things that we could do without.* Raise hands all who will repeat it? Harry? (He repeats.)

Who can now give me an example of a luxury? George? . . . . *Tobacco is a luxury.* Good. You mean by that we could live just . . . . *as well*, perhaps better, if it were not . . . . *used.* But there are people who are foolish enough to believe that it is a great accomplishment to smoke . . . . *tobacco.* They always have cigars or pipes in their . . . . *mouths.* But this is very foolish. A great many people ruin their health by its . . . . *use*, and then it does nobody any . . . . *good.* But it is still considered a . . . . *luxury.* And it is a very expensive . . . . *luxury.*

Now I want you to think of other luxuries. You may give your example, Kate . . . . *Wine.* Very good. Wine is another . . . . *luxury.* You mean by that, Kate, that we could . . . . *get along very well without it.* Like the last instance, it is often very . . . . *injurious*, much more frequently than it is . . . . *good*, or . . . . *beneficial.* Wine, and all other kinds of . . . . *liquor*, may be called . . . . *luxuries.* They are also useless and expensive . . . . *luxuries.*

I think you all know the meaning of this word now. Let us go a step further with our lesson. Although there are things daily used that are not . . . . *required*, there are yet others that we must have, without which we could not . . . . *live*. Bread is one of these things. It is the most important article of our . . . . *food*. We could not get along comfortably without . . . . *bread*. It is, therefore, not a luxury, but a . . . . ? There is another word that is the opposite of luxury. What is it? I will also write it beside the other. But before I do so I think you can tell me it if you try. Can you read in a book that you have never seen, with your eyes shut? . . . . *No, sir*. You would have to open your . . . . *eyes*, in order to . . . . *read*. Or, to state it differently, it would be . . . . *necessary*, to open your . . . . *eyes*. That is the word. I thought you could tell me. Bread, then, is a . . . . *necessary*. It is one of the NECESSARIES of . . . . *life*.

Now I would like to have you give me other examples of necessaries. Hands up. Hattie? . . . . *Warm clothing in winter is necessary*. That is a very good example. Yet we often see poor people who are almost without this which we find so . . . . *necessary*. And in some countries more than half of the people are deprived of some of the necessaries of . . . . *life*. We should be thankful that our wants are so well . . . . *supplied*, or . . . . *provided for*.

Can you think of others? Frank? . . . . *A warm fire is necessary in winter*. Is it not necessary in summer also? How should we cook our food? . . . . *Yes, sir; fire is always necessary*.

There are some things that were once LUXURIES, that have now become NECESSARIES. Can you mention one? Lizzie? . . . . *Tea*. That is correct. Once, in Europe, tea was unknown. When it was first brought from Japan and . . . . *China*, it was a great . . . . *luxury*. This was before the discovery of America. Now, it has become a . . . . *necessary* of . . . . *life*. We could not do quite as well without . . . . *tea*, and . . . . *coffee*. Sugar is another example.

(Now ask for as many examples of luxuries and necessaries as time will admit of. Such as paper, milk, pianos, lamps, schools, newspapers, carpets, silver-plate, etc.)

Let us complete our lesson. Those things that we cannot do without, are called . . . . *necessaries of life,* but those that are not absolutely . . . . *necessary,* to our comfort are . . . . *luxuries.* Thus bread is . . . . . *necessary,* while preserves would be . . . . *a luxury.*

———o———

LESSON XXXV.

NATURAL HISTORY: THE CAMEL.

Our lesson to-day is about the habits, structure and uses of the CAMEL. Let your answers be given promptly.

You all know what animals we use in this country as beasts of burden. Raise hands all who can tell me any of them. (Ask all who have their hands raised, and dispose of their answers. The horse, mule, ass, and ox should be given.)

These animals are all used for carrying . . . . *burdens,* or . . . . *loads.* But we do not, here, use the animal that we are to describe to-day, that is . . . . . *the camel.* It is used principally in the conutries of the Eastern Continent which contain hot, dry, sandy deserts like this country . . . . *Arabia*—(point to it on the map.) Repeat that Charlie. (He does so.) We will see how it is that this animal . . . . *the camel,* is so well . . . . *fitted,* or . . . . *adapted* (See Lesson II.) to those countries which contain hot, sandy . . . . *deserts.*

These deserts, as at the Isthmus of . . . . *Suez,* (point it out on the map) are sometimes hundreds of miles in extent, with nothing green to be . . . . *seen.* In these vast . . . . *deserts,* where there is no water, the horse or ox could not . . . . *live.* They would die of thirst, for men often travel there for weeks without meeting a single stream of . . . . . *water,* and it would be impossible to carry enough water for oxen or . . . . *horses.* People there use . . . . *camels,* which are exactly . . . . *adapted,* to these dry, arid . . . . *deserts.*

I must first inform you that the camel has **SEVEN**

STOMACHS. Annie, repeat this. (She does so.) The stomach is the place where the food is . . . . . *digested.* Now, one of these seven . . . . *stomachs*, of the . . . . *camel*, is exclusively devoted to the purpose of containing water. When it fills this . . . . *stomach*, with . . . . *water*, it has the power of using it only as it is absolutely required. It can travel for weeks across the hot sands of . . . . . *the desert*, without feeling any inconvenience on account of . . . . *thirst.* The men have to carry along their supply of . . . . *water*, but the . . . . *camel*, drinks its supply before they commence their . . . . *journey.* It has even happened that travellers have been out on the hot burning . . . . *deserts*, so long that all their supply of . . . . *water*, has become . . . . *exhausted*, or . . . . *used up;* and then they have been compelled to kill a . . . . *camel*, and use the water which they thus . . . . *obtained*, from the camel's . . . . *stomach.* But they prefer to go thirsty for several days before they consent to kill so useful and kind an . . . . *animal*, as . . . . *the camel.*

This is one reason why the camel is so well . . . . *adapted*, to life on a . . . . *desert.* Can you give me any other? Hands up. Well, I will ask a question. Would the feet the horse has, suit for the camel? . . . . *No, sir.* No; they would crack and become sore and uncomfortable on the hot, burning . . . . . *sand*, of . . . . . *the desert.* The camel must have a different kind of . . . . *foot.* How many have ever seen a camel? I see nearly all hands up. You have probably seen one with a circus, or in a menagerie. What kind of a foot has the camel? Dan? . . . . *It has a foot like —I can't tell.* Well, its foot consists of an immense pad. This is the best name that I can think of. It is a mass of soft flesh, which is the best foot that could be contrived for walking over . . . . *hot sand.*

The body of the camel, too, is sparingly covered with hair. Have you ever seen camel's hair? I see by your hands that you have; it is soft and silky in appearance, and is very valuable. If its coat of . . . . *hair*, was . . . . *heavy*, it would be too . . . . *warm.* As it is, it is just . . . . *right.*

The camel also serves the purpose of a cow. It gives . . . . *milk*, which is often almost the only food, with dates, of the inhabitants of these . . . . *deserts.*

When a burden is placed on the back of the .... *camel*, the animal is caused to kneel. At a certain signal, generally a whistle, from its .... *master*, the camel at once .... *kneels down*. Could it kneel UP? ..... *No, sir*. Then simply say that it .... *kneels*. (The kneeling of the camel to receive the burden is a most beautiful instance of the difference between mere TEACHING and TRAINING.) While it is quite young its keeper TRAINS it to .... *kneel*. He does not merely teach it, or show it how, but actually makes it DO the thing required. This is true .... *training*. And so the camel always does this when required. We said, when speaking of the cat, that a way of doing anything is a .... *habit;* the camel then forms this .... *habit*, and is always ready to .... *kneel*, at the signal of its .... *keeper*, to receive its .... *burden*. How nicely God in His wisdom has provided for the wants of the wanderers of .... *the deserts*.

(Now rapidly review, as in other lessons.)

LESSON XXXVI.

NATURAL SCIENCE: WHY DO IRON SHIPS FLOAT?

Now as soon as there is perfect silence we will .... *commence*. All must give their best .... *attention*. We are to have a lesson to-day that every boy will be interested in. The subject is, WHY DO IRON VESSELS FLOAT?

Who can tell me why? Well, we are about to investigate the matter. When a piece of wood is thrown upon the water, it does not sink but .... *floats*. Why? Let us inquire a little further. If I hold out this piece of .... *chalk*, and let go my grasp, it .... *falls*, to .... *the floor*. Why? I see several hands up. George? .... *Because the earth draws it down*, or .... *attracts it*. And if I hold a pail full of water, a little inclined, the water also runs down to .... *the ground*, because the .... *earth attracts it*.

Or, a piece of wood would be drawn to the . . . . *earth*, or . . . . *attracted*, in the very same . . . . *way*.

If I have a ball of lead, and a ball of pine wood of the same size, which is the heavier of the two? Frank? . . . . *The lead;* and if I place them on the extremities of a balance, which will outweigh the other? . . . . *The lead.* And consequently it will arrange itself nearer to the . . . . *earth*, as it is attracted more strongly than . . . . *the wood.*

Now let us go back to our former question. When we throw a piece of . . . . *wood*, upon the . . . . *water*, which do you suppose will get nearer the ground, the wood or the water? Alice? . . . . *The water will get nearer to the ground because it is the heavier.* Now let me ask a question of the whole school. Raise hands all who can tell me. Is a pound of water any heavier than a pound of wood? I will wait for you all to think of this. Well, Sam? . . . . *No, sir, it is not;* they both weigh . . . . *a pound.* Well, why, then, should a pound of wood thrown in about twenty pounds of water in a pail, float? I will tell you. When the wood is thrown upon the . . . . *water*, it sinks just a short . . . . *distance*, into the . . . . *water*, and consequently it drives so much water out of its . . . . *place*, as is equal to the quantity of wood immersed in the . . . . *water*. As I wish you all to clearly understand this, we will invert the sentence and repeat it. When part of the wood sinks into the . . . . *water*, there cannot be any water in the space occupied by . . . . *the wood;* or, the water that formerly occupied this . . . . *space*, before we threw in . . . . *the wood*, has been put out of its . . . . *place.* Raise hands those who do not yet fully understand this statement. (If any, transpose and repeat till all see what you mean.) Now can't we get a better term for "drives out of its place." You say that the wood drives or puts the water . . . . *out of its place*, or it . . . . . ? What prefix means APART or ASUNDER? (See Lesson XIII.) Ella? . . . . *Dis means apart.* Well, raise hands those who can tell what word will mean "to place apart?" Fred? . . . . . *Displace.* Well done. Displace means to . . . . . *drive out of place*, or simply, if "place" means TO PLACE and "dis" means APART, displace will mean to . . . . *place apart.* Then you would say that the wood . . . . *displaces the water;* that is, it . . . . *drives it out of its place.*

Well, I will tell you that if the wood, when sunk completely into the water, displaces a quantity of water greater than its own weight, it will float. Edward, repeat that. . . . . *If the wood, when sunk completely into the water, displaces a quantity of water heavier than itself, it will float.* Very well. And therefore if we put a cannon ball into water, since it displaces a quantity of . . . . *water,* that is . . . . *lighter than the ball,* the water in this case will float and the ball will . . . . *sink,* or go nearer to . . . . *the earth.* But if the cannon-ball had first been beaten out . . . . *flat,* and then formed into a large iron pan that would hold a great deal of . . . . *water;* yes, I know it would hold water, but if there were no water in it, it would then contain . . . . *air;* I repeat, if it were beaten out in that way so as to contain . . . . . *air,* the weight of the iron pan and air together, would be less than the water that would be . . . . *displaced,* and then the iron would not sink, but . . . . *float.*

Now who can tell why an iron ship floats? George? . . . . *The weight of the iron of the ship, with the air inside of it, is not so great as the water it would displace if put under the surface, and therefore it floats.* That is to say, it will only displace as much . . . . *water,* as is equal to its own . . . . . *weight.* But if we were to load an iron vessel full of shot, you think that then it would . . . . *sink.*

LESSON XXXVII.

ASTRONOMY: ATTRACTION OF GRAVITATION.

It always pleases me to see every one sitting in such a . . . . *position,* that the best attention can be . . . . *given.*

You could not lift a ton of iron in your hand. It would be too . . . . . *heavy.* What makes it heavy? Hands up.

Frank? .... *Its weight, I suppose, makes it heavy.* And do you not know better, Frank, than to make such a reply as that? You might as well say that birds fly because they fly. It must certainly have required great mental exertion to conceive such an answer. James, what do you think? .... *I think it is heavy because the earth attracts it.* That is very well answered. We have several times used this word .... *attract.* It means (See Lesson XIII.) .... *to draw to.* In which direction does the earth draw it? .... *It draws it downwards.* Now let us think carefully. If an immensely deep well were dug, extending .... *downwards,* to the earth's centre, and far beyond it to the opposite .... *side,* of the .... *earth,* and a cannon ball, or any other object, were dropped in, how far do you think it would fall? Hands up. Eva? .... *It would fall right through.* Now, be careful how you answer. George? .... *I think it would not fall through completely.* Well, let us see which answer is correct. I will allow the school to decide. What causes it to fall in the first place? Alice? .... *The earth attracts it.* Well, and when it has gone one-third of the distance through, there would be a great quantity of earth above it which would begin to draw or .... *attract,* it in the opposite .... *direction;* and on arriving near the centre, there would be just as much attraction drawing it .... *upwards,* as there would be to draw it .... *downwards.* (Make suitable gestures with the hand, indicating the direction. These gestures greatly assist in securing their attention.) And you could naturally think, as George did, that it would only go .... *half way through.* This is correct. Its force might cause it to descend a little more than .... *half way,* but it would soon stop and come .... *upwards,* and would probably oscillate as an evenly balanced scale would, and at last remain as near as possible to the centre of the .... *earth.*

I will now ask another question. Suppose that a man living upon the other side of the .... *earth,* were to drop another ball at that end into the .... *opening,* what do you think would become of it? I see a large number of hands up now. Sarah? .... *It would fall upwards into the hole.* Very good. That is to say, it would be upwards to us, but the person who dropped it would call it . . . . *downwards.* Downwards, then, means towards the earth's . . . . *centre,* and upwards . . . . *from the centre.*

This attraction, you say, it is that causes anything to possess . . . . *weight.* Now, I will tell you that the word that is used to represent this attraction is derived from the LATIN language, as many other words in English are. The Latin word GRAVITAS means weight; and because this attraction of the . . . . *earth,* causes . . . . *weight,* it is called . . . . *the attraction of gravitation.* Repeat that, Harry . . . . *The attraction of the earth, because it causes weight, is called the attraction of gravitation.*

In speaking of the solar system we stated that the earth itself is attracted by the . . . . *sun,* and that the sun attracts also all the other . . . . *planets.* The attraction of the sun, then, is also the attraction of . . . . *gravitation.*

Now, what is the shape of raindrops, or dewdrops, or tears? Hands up. Willie? . . . . *Round.* Round like a cent? . . . . *No, sir; round like a ball,* or . . . . *globular.* Why? Do you not see that the particles of the dewdrop all attract each other? Do you think it would, then, become square? . . . . *No, sir.* No, the form in which all the particles would be nearest to the centre, would be that of a . . . . *ball,* or . . . . *globe.* (Illustrate this with a square and also a circular figure on the black-board.) If you imagine the drop to be composed of layers, one on . . . . *another,* all the particles in each . . . . *layer,* would be equally distant from . . . . *the centre,* in the round form, but this would not be so if it were . . . . *square.* A mass of fluid, then, such as a raindrop, a dewdrop, or a . . . . *tear,* will, if left alone, become . . . . *round,* like a . . . . *ball.*

Well, it is supposed that our earth, which looks so solid, was once a melted mass. In that condition what would you have imagined its shape to have been? . . . . *Round like a dewdrop.* Very good. It would become round on account of this attraction which I have called . . . . *the attraction of gravitation.* And we know, and can prove, that this actually is its . . . . *shape.*

Now, we will revise, and I will give you a very beautiful selection from one of the poets, that you will always be able to remember, that very nicely embodies all that we have . . . . *said.*

Anything on its surface is attracted by . . . . *the earth.* This attraction is called . . . . *the attraction of gravitation,* from the Latin word . . . . *gravitas,* which means . . . . *weight,* because it is this that causes bodies to have . . . . *weight.* The attraction which the sun possesses towards the . . . . *earth,* and the other . . . . *planets,* is also a form of the . . . . *attraction of gravitation.* And dewdrops assume a round . . . . *shape,* in consequence of the same . . . . *attraction.* It is sometimes called the . . . . *Law of Gravitation.*

Here is the stanza. I will write it on the black-board, and wish you all to copy it into your note-books:

That very law which moulds a tear,
  And bids it trickle from its source,
That law preserves the earth a sphere,
  And guides the planets in their course.

(Cause them to repeat this stanza in concert several times.)

LESSON XXXVIII.

CHEMISTRY: SIMPLE AND COMPOUND BODIES.

Our attention is to be given to-day to a subject of great importance. (Do not state it till after the lesson is over). In order to receive the greatest benefit possible from a . . . . *lesson,* it is necessary to keep our thoughts about us and answer . . . . *promptly.* Then all sit . . . . *upright,* and look this . . . . *way.*

When you pick up a piece of glass, another of coal, still another of limestone, and also another of iron, they do not all appear to be exactly . . . . *the same,* or . . . . *alike,* but are, in appearance, all very . . . . *different.* All such things we include under one general name, (See Lesson x.) which is . . . . *matter.* Now, the first question which I have to ask you is: Do you consider that the iron, or the limestone, if examined, would be found to be each made up of a great many different kinds of substances blended, or mixed together, or of only one kind? Well, Annie? . . . . *I think that limestone is made only of one kind of matter, if it is pure, and so is iron.* Well, I will not now state whether that is correct or not, but will ask another question. If you examine a piece of soap, as pure as you can get it, do you think you would find that it consists of only one substance? . . . . *No, sir. It is made of grease, and soda or potash, and other things, often containing lime and water.* But could you tell this by merely picking it up, cutting it, and otherwise examining its outward appearance? . . . . *No, sir.* But you know how soap is . . . . *made,* and therefore you also know that it has in it more than one kind of . . . . *matter.*

Now when you see a piece of pure white marble, can you tell me whether it is only one, or several kinds of matter? Emma? . . . . *Only one.* Fred? . . . . *Several kinds.* Well, how do you know? I do not wish answers to be given which are mere guesses. I wish you to think for yourselves and reason, and draw correct conclusions. If you break the marble, which is pure limestone, or rub it, or scrape it, or examine it in any such way, so as to only investigate its outside properties, if you even find its weight, or look at its color, there is nothing to tell you whether it is just one kind of . . . . *matter,* or whether it contains . . . . *several kinds.*

Or if we take coal, and examine it in the same . . . . *manner,* we cannot tell how many kinds of . . . . . *matter,* it . . . . . *contains.* Well, how are we to tell? Let us see. (Procure a small glass tube. Have one end open and the other closed. Get some small pieces of nice clean white wood. Place them in the tube and hold it in the flame of a spirit lamp, so as to strongly heat the wood. It very soon decomposes. The lamp may be made by perforating a cork, passing a brass, iron, or tin tube through it, and fitting the cork into a small phial with a large mouth. Have a wick, of course, and burn alcohol in it.) The wood that I have placed in this . . . . *tube,* now begins to become quite . . . . *black.* If we had examined it by merely handling it, we never could have found out what composed it. But when we apply . . . . *heat to it*, we soon know that the wood is made up, or . . . . *composed*, of a number of different kinds of . . . . *matter*. You see around the sides of the tube a substance like tar (if you use pine wood), and the solid black substance at the end of the tube is . . . . . ? It is CHARCOAL. This is the way in which charcoal is . . . . . *made*. Wood is covered over with earth, to keep away the air, and then heated. The heat soon separates it into different kinds of . . . . . *matter*. Well, can you give me one word for separating into parts? When you separate a sentence into its . . . . . *parts*, or take apart and explain a process in arithmetic, you are said to . . . . *analyze it*. That is just the word I wanted. I think you can all remember it. The wood becomes . . . . . *analyzed*. And this process is called ANALYSIS. The wood is analyzed by . . . . *the heat*.

Now, the science which teaches us about the analysis of different . . . . . . *substances*, and shows us of what they are . . . . . *composed*, is called CHEMISTRY. Let me hear this word from all . . . . *Chemistry*. And chemistry teaches us that all substances are not composed of one single kind of . . . . *matter;* many are made of several . . . . *kinds*, just as we found that this . . . . *wood is*. I will now tell you that all those substances which are known to be made up or . . . . *composed*, of only one kind of . . . . . *matter*, are called SIMPLE BODIES. And those, like wood, which contain more than one kind of . . . . *matter*, are called COMPOUND BODIES. Then, will wood be simple or compound? Hands up. Ella? . . . . *Wood is compound*. And can you tell me what water is? John? . . . . *Water is simple*. Why do you think so, John? . . . . . *Because heat does not analyze it; it only changes it into vapor, which can be converted back again to water*. That looks like a good reason, John, but I am sorry to have to contradict you. That answer, however, convinces me that John had thought carefully of what he . . . . . *said*. I would give ten times as much for an independent answer like that, with a reason for it, than a thoughtless, careless answer with no reason. I will tell you, John, that there are other ways of analyzing besides by heat. We will speak of them in a future lesson. Water is found to consist of two gases. I will also describe them in a future lesson. One of them is oxygen, of which we have already . . . . . *spoken.* It is the principal gas in . . . . *the air.* Iron is found to be simple, that is, it is . . . . . *only one kind of matter.* What do you think of coal? George? . . . . *It is compound; for it contains more than one kind of matter. There are the ashes, and other substances that are burned out of it.* Very well; that is another excellent answer, accompanied with a good reason. Always have a reason for what you . . . . *say.*

Some bodies, then, like iron, are . . . . . *simple;* and others, such as wood, are . . . . *compound.* They are simple when they contain . . . . *only one kind of matter;* compound if . . . . *they contain several kinds.* When we find this out, as with heat, we . . . . *analyze them.* The science which treats of analysis is . . . . *Chemistry.*

LESSON XXXIX.

NATURAL SCIENCE: INERTIA.

Now, all look this . . . . *way,* and be ready to . . . . *answer.*

Iron, rock, sand, water, and all other things that we find around us, may be called by one name, which is . . . . *matter.* (See Lesson x.) And matter has a great many curious properties, as they are called. For instance, the earth attracts all objects on its . . . . *surface,* towards it, and thus causes them to have . . . . *weight.* Weight, then, is one of the properties of matter. Or a better name is the other word. What causes weight? . . . . *Attraction of Gravitation.* (See Lesson XXXVII.) Attraction, we say, is a . . . . . *property of matter.* Well, we will to-day speak of some other properties that it . . . . *possesses.*

You all see this book lie open upon my desk. Has it any power to move? . . . . *No, sir.* You think it cannot put itself in . . . . *motion*, or it is unable to. . . . *move*. Can any one think of a word that means "unable to move?" I will give you one. INERT. Anything that is inert is unable to . . . . *move*. Lizzie, repeat that . . . . *Anything that is inert is unable to move.* And this is considered another property of . . . . *matter;* its being unable to . . . . . *move*, or being . . . . *inert*, is another . . . . *property*. It is called by a hard name. I will write it. INERTIA. You may all repeat it . . . . *Inertia*. This is the property of not being able to . . . . . *move*, or of being . . . . . *inert*, or inactive. What is inertia? Charlie? . . . . . *Inertia is the property of being unable to move.*

Inertia is a very curious property of matter. Let us look at some instances. When a boy is standing on a sleigh or in a buggy that is not moving, and all at once it is caused to move rapidly, what happens? Fred? . . . . *He is caused to fall over backwards.* Very good. And this is because his body, while at rest, has no power to put itself in . . . . *motion*. Of course, we mean without moving the feet. Again, when a boy is on the back of a horse that is standing still, he has to be careful if the horse moves . . . . *suddenly*, or . . . . *quickly*, or he would . . . . *fall off*. (Here perform this experiment. Place a card two or three inches square on the tip of the finger. Then place a large cent on the card, balanced so as not to fall off. As you hold it out on the finger, give the card a smart tap with the second finger of the right hand, let go from the thumb. The card will fly off, and leave the cent immediately resting on the finger.) Now all watch what I do. Why did the cent not fly off with the card? Why did the card not carry the cent off on its back? It was resting on the card. Annie? . . . . *You moved the card, but imparted no motion to the cent; so it remained on your finger because it had no power to put itself in motion.*

Now I will also tell you that this property of . . . . *matter*, which we have called . . . . *inertia*, means more than this. After a body is put in motion it is impossible for it to stop. Well, Sam, I see your hand up . . . . *I do not think so. Roll a ball on the grass, and it very soon stops.* Wait a moment, Sam; not so fast. Does the ball stop, or does something else stop it? . . . . *The grass stops it.* And if you were to roll it on ice, it would roll for a very long . . . . *time*, or . . . . *distance.* But, at last, because it rubs against . . . . *the ice*, on account of the earth so strongly . . . . *attracting it*, and also since it is resisted by the . . . . *air*, through which it . . . . *moves*, the ball would . . . . *stop.* But if it were away off in clear space, and were set in . . . . *motion*, you can easily see that it would never . . . . *stop*, until . . . . *something stopped it.* And so, when a horse is running fast with a person on his . . . . *back*, if a dog or bear were to frighten him so as to make him stop very . . . . *suddenly*, the boy would most likely, unless a good rider, go . . . . *over his head.*

When we say that inertia is a property of . . . . *matter*, we not only mean that resting bodies cannot . . . . *move*, but also that . . . . *moving bodies cannot rest.* I will write the definition on the black-board. INERTIA IS THE PROPERTY OF MATTER BY WHICH BODIES AT REST CANNOT PUT THEMSELVES IN MOTION, AND BODIES IN MOTION CANNOT REST. We will repeat it. Inertia is that . . . . *property of matter*, by which bodies at rest . . . . . *cannot move*, or put themselves . . . . *in motion*, and bodies in . . . . *motion cannot rest.* What is this property called? James? . . . . *It is called inertia.*

(This property can be illustrated very beautifully by what is called the "doubling" of a hare when pursued by hounds.)

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LESSON XL.

HUMAN ANATOMY: ARTERIES OF THE BODY.

Now all your attention must be concentrated on our . . . . *lesson.* I am about to tell you to-day the names of the most important ARTERIES in the body.

When we speak of the circulatory system we mean the system of . . . . . *blood-vessels*, which contain . . . . *the blood*, and circulate it through . . . . . *the body.* It consists (See

Lesson XX.) of, 1st, ... *The heart;* 2d, ... *The arteries;* 3d, ... *The capillary vessels;* and 4th, ... *The veins.* You must always remember that the blood flows FROM the heart through .... *arteries,* and TO it .... *through veins.*

The first artery that we will name is the large one that leads from the left .... *ventricle,* of .... *the heart.* (Here you may rapidly revise Lesson XXII.) It is called the AORTA. I have written it. We will place the names, as they occur, upon the ..... *blackboard.* All answer this word .... *Aorta.* What about it? Ella? .... *The aorta is the largest artery in the body. It comes from the left ventricle of the heart.* On leaving the heart it bends and passes downwards through the trunk of the body. Its name, again, is .... *the aorta.*

Now, as the aorta passes downwards, it sends off smaller arteries which pass around between the ribs, to the front of the .... *body.* These are named from the fact that they run between .... *the ribs.* The word that means "between the ribs" is INTERCOSTAL. Then these are the .... *intercostal arteries,* which run from the .... *aorta,* around the .... *body,* between .... *the ribs.*

As the aorta extends downwards still further it gives off other ..... *branches.* These, because they pass to the loins are called LUMBAR arteries. The word LUMBAR means belonging to the .... *loins,* which is that part of the .... *body,* near the "small" of the .... *back.*

We have now three names. Anna, give the first .... *The aorta is the large artery, and comes from the left ventricle of the heart.* Charlie, the next .... *The intercostal arteries are those that run between the ribs.* Mary, the next .... *The lumbar arteries run to the loins.* Very well. At last the aorta, after traversing the trunk, separates into two .... *branches.* These two are named from the scientific name of the thigh bone, which is called the FEMUR. (See Lesson XVIII.) They pass down on the inner sides of the thigh bones, and are called the FEMORAL arteries. The two branches of the ..... *aorta,* then, that pass down through the thighs, are called the .... *femoral arteries.*

At the knee each femoral artery separates again into two .... *parts,* one of which is called the ANTERIOR, and the other the POSTERIOR TIBIAL arteries. They receive these names from one of the bones of the leg, the tibia. (See Lesson XVIII.) The posterior tibial artery runs down BEHIND the tibia, and the anterior tibial artery BEFORE it.

Now we will again revise before proceeding. First we have . . . . *the aorta;* 2d, ... *the intercostal arteries*, between . . . . *the ribs;* 3d, ... *the lumbar arteries*, running to . . . . *the loins;* 4th, ... *the femoral arteries*, in the . . . . *thighs;* 5th, ... *the anterior and posterior tibial arteries.* These divide, at the ankles, into smaller branches extending to . . . . *the toes.* The arteries of the toes are called DIGITAL arteries. Those of the fingers are also called . . . . *digital.* The Latin word DIGIT means A FINGER. So the arteries of the fingers and toes will most likely be called . . . . *digital arteries.*

Now we will go back and name those arteries that pass . . . . . *upwards*, and to the . . . . . *arms.* From the aorta two branches pass up through the neck, called the CAROTID arteries. (Accent on the second syllable.) Let us all repeat these names as I point to them . . . . *Aorta; Intercostal; Lumbar; Femoral; Anterior Tibial; Posterior Tibial; Digital; Carotid.*

Next we have those that supply the . . . . *arms*, with . . . . *blood.* The artery of the arm first passes beneath the collar bone or CLAVICLE (See Lesson XVIII.), and is hence called the SUBCLAVIAN artery. SUB, you know, means *under*, and subclavian will mean passing . . . . . *under the clavicle.*

Then as it passes down the upper arm, it is called the AXILLARY artery. (Accent on first syllable.) Let me hear these last two names from all . . . . *subclavian*, and . . . . *axillary.* This artery, in the . . . . *arm*, is called, as it passes under the . . . . *clavicle*, the . . . . *subclavian artery*, and in the upper arm . . . . *the axillary artery.*

The axillary artery, at the . . . . *elbow*—(point to the elbow, and when you require such an answer, always use a gesture, to keep the attention and indicate your answer, only those who are looking can answer,)—separates into two . . . . . *branches.* One follows the ULNA and the other the RADIUS, the two bones of the lower .... *arm.* (See Lesson XVIII.) Hence they are called the ULNAR and RADIAL arteries. All repeat. They are the..... *ulnar,* and ..... *radial arteries.* They receive these...... *names,* from those of the bones of .... *the lower arm,* the .... *ulnar,* and .... *radius.*

We have already said that the arteries from the .... *wrist,* to .... *the finger-ends,* are called .... *digital.*

And now we will rapidly recapitulate. The blood flows from the left.... *ventricle,* of .... *the heart,* into .... *the aorta;* from this branch of the ..... *intercostal arteries,* which lie .... *between the ribs.* Then it also gives off the .... *lumbar arteries,* going to .... *the loins;* next it separates into .... *two parts,* the .... *femoral arteries,* which in their turn separate and form the anterior and posterior .... *tibial arteries,* and these form also ..... *the digital arteries,* of the .... *toes.* Proceeding upwards to the .... *neck,* are the .... *carotid arteries;* and passing under the clavicle or collar bone are ..... *the subclavian arteries,* which, in the upper arm, take the name of.... *axillary arteries;* these, at the .... *elbows,* separate into .... *two branches each,* one called the ..... *ulnar artery,* and the other.... *the radial.* They get these .... *names,* from those of the .... *bones of the arm,* which are .... *the ulna and radius.* The ulnar and radial arteries at length form the .... *digital arteries,* of the .... *arm.*

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LESSON XLI.

THE ARTS: WEAVING.

When we spoke of MEMORY we stated that it would be quite impossible to remember a thing in which we take no .... *interest,* or do not .... *understand.* Now you will demonstrate that you take an .... *interest,* in our .... *lesson,* if you give good .... *attention.*

What we KNOW about anything is called a . . . . *science*, (See Lesson XXXII.) and what we DO, depending on that . . . . . *science*, is called . . . . . *an art*. Then an art is a method of . . . . *doing something*. The art of painting is the art or way of making . . . . *pictures*, by . . . . *painting*. It is one of the Fine Arts. And you would call a man who practices the Fine Arts an . . . . *artist*. What is an artist? Carrie? (She repeats.)

To-day our lesson is on one of the Arts, the ART OF WEAVING. This, you know, is the art of making . . . . *cloth*. I called it the art of . . . . *weaving*. The instrument with which cloth is made is called . . . . *a loom*. In large manufactories they operate a great number of . . . . *looms*.

Then we will first speak of the different things of which cloths are . . . . . *made*. Books are made of . . . . *paper*. And the paper is called by a certain name because the book is made of it. The paper is called the . . . . ? Let me write the word. MATERIAL. The paper is the . . . . *material*, of which . . . . *the book is made*. Annie, of what material are combs generally made? . . . . *Combs are made of India-rubber and horn*. And the horn or . . . . *rubber*, we call the . . . . *material*, of which . . . . *the combs are made*. And cloth is manufactured of certain kinds of . . . . . *material*.

Now you can all understand that substances like sand or sawdust would not do to make . . . . *cloth*. What kind of materials or substances are used? Only those that are . . . . ? There is a word which means consisting of long hairs. It is FIBROUS. This means consisting of . . . . . *fibres*, or . . . . *hairs*. Cloth, then, can only be . . . . *made*, from substances that are . . . . *fibrous*, or consist of . . . . *fibres*. Willie, repeat that. (He repeats.) Well, you may now raise hands to mention substances that are . . . . . *fibrous*, of which cloth . . . . *is made*. Mary? . . . . *Cotton*. Sam? . . . . *Wool*. Ellen? . . . . *Hair*. John? . . . . *Grass of some kinds*. Yes, coarse cloths called stair-cloths are made from . . . . *grasses*. Emma? . . . . *Flax*. Sarah? . . . . *Silk*. Well, that is enough. Hands down. We may say that anything that is . . . . *fibrous*, can be . . . . *manufactured* *into cloth.* Or, inverting our sentence, all kinds of fibrous .... *substances*, or, the other word .... *materials*, can be used for .... *manufacturing cloth.*

We said in one of our former lessons (See Lesson XIX.) that all those substances which are derived from the organs of animals and plants are called .... *organic.* Now raise hands those who can tell me whether the materials used are ORGANIC or INORGANIC. Libbie? .... *They are organic.* Then we will introduce this word into our statement. All organic .... *materials*, that are .... *fibrous*, are suitable for .... *weaving.* Who will repeat this? Annie, you may do so. (She repeats. Call on others for a full statement.)

Now you have doubtless often heard a building called a FABRIC. Raise hands those who have. Well, I see that some have. Hands down. Anything made in a loom, that is, any kind of an article that is .... *woven*, is also called by this name, a .... *fabric.* When it is nice and fine, it will be a delicate .... *fabric*, but such articles as stair-cloths or carpets would be coarse .... *fabrics.* The name fabric then is often given to articles that are .... *woven*, or made in a .... *loom.* Mary, repeat that. (She repeats.) Alice, what kind of a fabric would you call silk? .... *Silk is a beautiful delicate fabric.* And muslin is also a .... *delicate fabric.* Besides being delicate, since they are woven, they are called, as I now write, TEXTILE FABRICS. Delicate textile fabrics are generally more expensive than .... *coarse ones.*

Now, let us review. What we KNOW is a .... *science*, and what we DO is called .... *an art.* Our lesson to-day is about .... *the art of weaving*, or of making .... *cloth.* Cloth is manufactured in an instrument called .... *a loom.* Those substances of which we make .... *cloth*, are called the .... *materials;* and cloth cannot be made from such materials as sawdust or .... *sand*, but from .... *fibrous materials.* Since these materials are derived from the organs of plants and .... *animals*, they are called .... *organic.* You may now supply these three words. Cloth is made of .... *fibrous organic materials.* Anything woven is said to be .... *textile.* Cloth is a .... *textile fabric.* Such things as carpets are very .... *coarse fabrics*, while muslin, or crape, or fine silk is . . . . *a delicate fabric.* We will continue this lesson at another . . . . *time.*

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LESSON XLII.

HISTORY: CAREER OF NAPOLEON.

To-day we are to have a lesson in HISTORY.

Everything that happens to nations, and to the most remarkable men, is written down and called by this name. It is called . . . . *History.* Let me write a good definition, or meaning, of the word History on our . . . . *blackboard.* HISTORY IS A RECORD OF REMARKABLE EVENTS. If I speak of UNITED STATES HISTORY, I am talking of the record of . . . . *events,* that occurred in . . . . *the United States.* And what would we mean, Fannie, by a History of Minnesota? . . . . *A History of Minnesota would be a record of events that happened in Minnesota.*

We are to speak of some events in French History that are connected with the life of NAPOLEON. He was one of the Emperors of . . . . *France.* His life was very remarkable, and is equally interesting. Of whom are we to speak? Hands up. Harry? (He repeats the subject.)

Does any one know when and where Napoleon was born? I will tell you. He was born in the city of AJACCIO, (pronounced A-yat-ce-o,) in the Island of CORSICA, which is in the . . . . *Mediterranean,* and belongs to . . . . *France.* James, repeat that . . . . *Napoleon was born in Ajaccio, in Corsica, an island in the Mediterranean belonging to France.* Raise hands all who can repeat it. Well, hands down. We wil go further.

This was more than one hundred years ago. He was born in the year 1769. When he was about sixteen years old, he was sent to a military school, to learn to be . . . . *a soldier.* This school was in Brienne, a city near Paris. Napoleon, we will repeat, attended the . . . . *military school,* at . . . . *Brienne*, a city of . . . . *France*, near the city of . . . . *Paris*. While there, he often signalized himself by his bravery and skill during sham-fights. Batteries were often constructed in winter, of . . . . *snow*. Then, the storming party with Napoleon at their head as leader, never failed to defeat their opponents, and capture their . . . . *batteries*. In this way he acquired a taste for the life of . . . . *a soldier*. And so he joined . . . . *the army*. Yes, he joined the French army, and very soon had excellent opportunity of showing his talents—his military . . . . *talents*.

All repeat. We are now speaking of . . . . *Napoleon;* he was born in . . . . *Ajaccio*, a city of . . . . *Corsica*, an island in the . . . . . *Mediterranean Sea*, in the year . . . . . 1769. When about sixteen, he entered the . . . . *military school*, at . . . . *Brienne*, a city near . . . . *Paris*. While there he often showed his . . . . *skill*, and . . . . *courage*, when storming the . . . *snow batteries*, of the opposing . . . . *force*.

Now, I will tell you that shortly after he joined the . . . . *French army*, he had to accompany the troops to a city in the South of France. Its name is TOULON. (Pronounced Too-long. The g only faintly.) The French troops were besieging the city of . . . . *Toulon*. A little incident occurred here which showed his appreciation of bravery. He was dictating a dispatch to a sergeant who was writing on a drum-head, when a cannon-ball came whizzing past and tore away the ground just beside them, causing some sand or dust to drop on the paper. Instead of showing any signs of fear, the sergeant simply remarked to Napoleon, "We won't need any sand (or blotter) on this document." For this evidence of heroism Napoleon afterwards procured his promotion.

Shortly after, Napoleon was called to the capital of France, to . . . . *Paris*, to take charge of the government troops, against the revolutionary forces. Here he gained a brilliant victory with a mere handful of men against a force ten times as strong. On this account he received command of the French army which had been fighting in Italy. It had met with very little success; but, on the other hand, it had been many times . . . . *defeated*. The entire army, when Napoleon took charge of it, had been driven almost to the summits of the mountains that separate .... *France*, from .... *Italy*. (Point to each on the map.) They are called the .... *Maritime Alps*. Those who composed the .... *army*, away up among the glittering summits of the .... *Maritime Alps*, were almost perished by .... *cold*, and famished with .... *hunger*. They had no heart to engage in .... *battle*. This was because they had not a good leader. For a leader, they were now to have .... *Napoleon*. When he took charge of the army he addressed them thus: "My good, brave fellows, I am sorry to find you so uncomfortable and miserable. But cold, hunger and exposure form the school in which good soldiers are trained. Follow me, I will soon lead you on to comfort, plenty, fame and victory!" Now what effect do you consider that words like these would have? George? .... *I think that the soldiers would take courage, and fight bravely*. Well, that is just what they did.

The first thing that Napoleon did was to make up a plan. In war, a plan is called a ....? It is called a STRATAGEM. The Austrian and Italian armies had now followed them to the mountains that lie between .... *France and Italy*. So Napoleon thought that the best thing that he could do would be to go round quietly and get between them and their own ..... *country*. They could not then get any supplies, or any help, or .... *assistance*. Well, they rushed down the mountain slopes; and their manœuvre, or as I called it before a .... *stratagem*, succeeded so well that they entirely defeated the .... *Austrians*, and .... *Italians*. They then captured the city of TURIN, and at length got possession of all the fortresses of Northern ..... *Italy*.

In order to continue this narrative, we will have to wait till we can put it in another .... *lesson*.

All review rapidly. Our lesson is about .... *Napoleon*. He was born in .... *Ajaccio*, a city in the island of ..... *Corsica*. He was educated in the military .... *school*, of .... *Brienne*, a city near .... *Paris*. He distinguished himself after he joined the .... *army;* first, ... *at the siege of Toulon*, and second, ... *at an engagement near Paris*. He was then placed in command of the French

.... *army*, that was operating in ..... *Italy*. He found them almost .... *starved*, and .... *discouraged*, but soon led them on to .... *victory*.

LESSON XLIII.

CHEMISTRY: ACIDS, BASES, AND SALTS.

We have before stated that such substances as wood, or soap, which are composed of different kinds of .... *matter*, are said to be .... *compound;* but others, like iron, being only one kind of .... *matter*, are .... *simple*. (See Lesson XXXVIII.)

Raise hands those who have seen limestone. Well, I see that you all have. I have a piece of marble here, which is pure limestone. When limestone is burned in a .... *kiln*, it becomes .... *lime*. Now is there any difference between limestone and lime? George? ..... *When water is poured on lime it produces a different effect to that caused when poured on limestone.* James? .... *The lime is lighter than limestone.* Harry? ..... *Lime is softer than limestone.* Now what is it that makes this change in the limestone while in the kiln? I wish you all to raise hands who can tell me what the change is that the limestone undergoes when it becomes lime.

What do you say, Harry? .... *The fire dries the water out of the limestone.* Let us see whether this is so or not, Harry. He says that while in the ..... *kiln*, the heat expels the .... *water*, from the .... *limestone*, or dries it, thus converting it into .... *lime*, and causing it to become much .... *lighter*. Now, Harry, if this were so, by pouring more water on the lime, after taking it from the .... *kiln*, we could restore it to its former condition, causing it to again become .... *limestone*. But George said a few moments ago that this would not happen. Does lime become limestone when water is poured upon it, George?

. . . . *No, sir, it crumbles and dissolves, while limestone will not do that.* Then we have proved that it is not by drying out the . . . . . *water*, that limestone becomes . . . . . *lime.* Well, how is it? As there are no hands up, I will tell you. I will always give you facts, but let you draw your own conclusions.

The limestone is found to be composed of two substances. The first is that which is taken from the kiln after it is burnt. It is the . . . . *lime.* The second is a gas. It is the same as one of the gases that comes forth in our . . . . . *breath.* (By a gesture they will understand what answer to make here.) It is called CARBONIC ACID GAS. The first we called LIME. Now who can tell me the names of the two substances that compose limestone? Libbie? . . . . *Limestone is composed of lime and carbonic acid.*

By its name you see that this gas is an ACID. I will be able to tell you better what an acid really is in a future lesson. Acids, like vinegar, are distinguished by a sour . . . . *taste.* This gas, which we called . . . . *carbonic acid gas,* also has a sour . . . . *taste;* but as it is a gas it is only slightly sour. Still, it is an . . . . *acid.* Then the lime with which this . . . . *acid,* combines, is called the BASE. So an ACID is said to combine, or unite with a BASE. You may repeat that, Mary . . . . *An acid is said to combine with a base.*

When lime combines with carbonic acid, which is the acid, and which the base? Hands up. Eddie? . . . . *Carbonic acid is the acid, and lime is the base.* And what would you call the limestone, which is formed of these two? Let me write it. It is called a SALT. That which is formed of an acid and a base is called . . . . *a salt.* Limestone, then, is . . . . *a salt.*

You have all seen common salt. As its name shows, it is . . . . *a salt.* Then it must be composed of an acid and . . . . *a base.* Then, is it simple or compound? Ella? . . . . *It is compound.* Now, I will tell you that the acid which combines with a . . . . *base,* to form common . . . . *salt,* is not properly an acid. But it takes the place of an acid, and therefore we will call it an . . . . *acid.* It is called CHLORINE, and the base is called SODIUM. The chemical name of salt is CHLORIDE OF SODIUM. This is the best name, for it shows the name of the acid and also the base.

Now for a rapid review. The acid of common salt is .... *chlorine*, and the base is .... *sodium*; the salt which they form is ..... *chloride of sodium*, which is another name for .... *common salt.* Limestone is also a .... *salt*, although it does not dissolve like common .... *salt.* In it the acid is .... *carbonic acid*, which is a kind of .... *gas;* and lime is ..... *the base.* And, generally, we say that an acid combines with .... *a base*, to form .... *a salt.* Who will repeat this? George? .... *An acid combines with a base to form a salt.*

LESSON XLIV.

HISTORY: FIVE GREAT NATIONS OF ANTIQUITY.

I suppose that you all know that the oldest history that we have is contained in the Bible. This book tells us of the oldest nation of which we have any .... *history.* It was a great nation, and had very powerful kings. It contained some immense cities, so we are told in .... *the Bible*, where we find its ..... *history.* But they have been destroyed, and no longer .... *exist.* Not even their ruins are to be .... *seen.* They have been buried beneath the sods of ages. The people of this ..... *nation*, are no longer known as a nation, and perhaps do not exist at all. What nation was this? The oldest nation of which we read in the Bible? Hands up.

I see that no one can tell me. All listen attentively. It was the BABYLONIAN nation. Or, simply, BABYLON. It also had another name. ASSYRIA. The first name I gave you, all answer ..... *Babylon*, or, the other .... *Assyria.* It was in that part of the world which is called ASIA MINOR. Do you remember the names of any of its cities? George? .... *Babylon was one.* Yes, and another was NINEVEH.

Babylon and . . . . *Nineveh,* were the two largest . . . . *cities,* in the kingdom of . . . . . *Babylon,* or . . . . *Assyria.* This was the oldest nation of which we . . . . *have any history.*

At length this kingdom was overthrown by another that was also very powerful. It has likewise ceased to . . . . . *exist.* It was the PERSIAN kingdom. Let me hear it from all . . . . . *The Persian kingdom.* What about it, Alice? . . . . *It was the second kingdom of antiquity.* Did I say so? . . . . *No, sir.* Well, George? . . . . . *You said it conquered the Babylonian kingdom.* Very well. Now I will tell you that before it arose to power and eminence, another nation had arisen in the northern part of Africa, in this country . . . . *Egypt.* (Point to it on the map.) What would you call the name of this kingdom? Hands up. Frank? . . . . *It would be called the Egyptian kingdom.* Right. I will also place this on our blackboard. EGYPTIAN. This was the second . . . . *kingdom.*

First, ... *the Babylonian;* 2d, ... *the Egyptian;* and 3d, ... *the Persian,* which conquered . . . . *the Babylonian kingdom.* The first and third were in . . . . . *Asia;* the second . . . . *was in Africa.*

Then there were still two others. They were both in . . . . *Europe.* (Pointing to it.) One was in this country . . . . *Greece.* What will we call it? . . . . Emma? . . . . *It is the Grecian kingdom,* or . . . . *nation.* It had a great king, who conquered all the rest of the world, and then cried because there was nothing more to . . . . . *conquer.* His name was ALEXANDER THE GREAT. Well, Sam, I see your hand up. . . . . . *Did he conquer the United States?* No, Sam, he did not. The people of our country came from . . . . *Europe,* since the discovery of . . . . *America.* But Alexander lived many hundreds of years before this. He conquered all the world that was then . . . . *known,* which was only portions of the eastern . . . . *continent.* Each of these . . . . *kingdoms,* in its turn, conquered the rest of . . . . *the world.*

After some time another nation arose which conquered the . . . . *Grecian nation,* as well as the rest of . . . . *Europe.* It received its name from the city that was the capital of the empire, this city . . . . *Rome.* Hence it was called the . . . . . *Roman nation.* Let me write it with the others.

ROMAN. It was during the existence of the Roman empire that our Saviour was born. Christ was born in a country that belonged, as all others did, to . . . . *Rome.* He was born in . . . . *Palestine.* The Roman empire was so powerful that Rome was called "The Mistress of the World." Let me see how many will remember this quotation from a celebrated poet:

"Where Rome, the Mistress of the World,
Of yore, her eagle wings unfurl'd.,'

What do you think, Sam, is meant by "unfurling her eagle wings?" . . . . *I suppose they had an eagle, as we have, for a national emblem.* That is correct.

Now let us recapitulate. The first of these five . . . . *kingdoms*, of . . . . . *antiquity*, was . . . . *the Babylonian;* 2d, ... *the Egyptian;* 3d, ... *the Persian*, which conquered . . . . *the Babylonian;* 4th, ... *the Grecian;* 5th, ... *the Roman.* The Babylonian was also called . . . . *the Assyrian.* One of the kings of the Grecian kingdom was . . . . *Alexander the Great.* And it was during the time of the Roman . . . . *kingdom*, that Christ . . . . *was born.*

LESSON XLV.

MANUFACTURES—BROCADED SILK; JACQUARD LOOM.

The materials used for producing cloth, (See Lesson XLI.) are derived both from the vegetable and *animal kingdoms.* Those derived from the latter, the . . . . *animal kingdom*, are the most important. Perhaps the most valuable is the one of which we will speak to-day, SILK.

Of the countries of Europe the most noted in the production of silk fabrics is the one to which I now point . . . . . . *France.* In the south of . . . . *France*, mulberry bushes, on whose leaves the silk-worms . . . . . *feed*, grow abundantly, and the climate is neither too cold nor . . . . *too warm*, for raising the silkworms themselves, or for producing the finest quality of . . . . . *silk.* Just at this point, where the Saone flows into . . . . *the Rhone,* which you would call their . . . . *confluence,* is situated the city of . . . . *Lyons.* Repeat that, Harry. (He repeats.) Raise hands all who can. The two whose hands are not raised, Angus and Emma, will remain at recess, when I will assist them to prepare this statement upon their slates. All repeat together . . . . *Lyons is at the confluence of the Rhone with the Saone.* It is in the southern . . . . . *part of France.* This city was the most celebrated in all Europe for a very long . . . . *period,* for the production and . . . . *manufacture,* of . . . . . *silk.* Kate, you may now state all about Lyons.

The particular kind of silk made there was known as BROCADED SILK. Let me hear these two words from all . . . . *Brocaded silk.* Raise hands all who know what brocaded silk is. Hattie? . . . . *It has flowers on it.* Painted on? . . . . *I do not know, sir.* Does any one know? I will tell you. It has the appearance of having flowers and other patterns, or designs, IN RELIEF, or raised upon its surface, while it is really perfectly smooth. You may repeat this, George. (He does so.)

Brocaded silk was formerly exceedingly difficult to . . . . *make,* or . . . . *manufacture.* The loom in which it was . . . . *made,* was very imperfect. Those parts called treadles, which are usually moved by . . . . *the feet,* had to be operated by children. This was a very unfortunate thing for these . . . . *children,* both physically and intellectually, that is both for their bodies and . . . . *minds;* for they could not attend . . . . *school,* having to work all . . . . *day,* and some two or three being required for each . . . . *loom.* But this was not all. From being in this position all . . . . *day,* the chest became . . . . *contracted,* or . . . . *drawn together,* which induced disease that ended in . . . . *death.* No silk-weaver, for this very reason, lived over thirty-six or forty years. This was a very sad thing. The children, you see, would grow up with weak, sickly . . . . . *bodies,* and undeveloped and ignorant . . . . *minds.*

At length the Emperor proposed to bestow a great reward upon any one who would invent a . . . . *loom,* that would not require the . . . . *children's labor.* Several men went to work on the problem. The successful man was Marie Joseph Jacquard. This skilful Frenchman invented . . . . *a loom,* such as was . . . . *required.* It made the finest kind of . . . . *brocaded silk,* and relieved the . . . . *children,* from their . . . . *labor.*

But we are now about to see the sad effects of ignorance upon people, however skilful they may be in the arts. These silk-weavers of . . . . *Lyons,* reasoned very falsely about the matter. They concluded that it would make them much poorer—poor as they were already. They said, "If this new . . . . *loom,* makes more and better . . . . *silk,* and does not require the aid of . . . . *children,* it will lower the price of . . . . *silk,* and we will starve." And, however unaccountable it may appear to us, they actually forcibly took Jacquard's . . . . *loom,* out of his . . . . *home,* and burnt it on the public square. Who can state again what happened to the Jacquard loom, and why? Carrie? (She states it.)

In a future lesson I will tell you other interesting facts about these things, as I have not time in this lesson. But before we close, let us review. Of the materials used for . . . . *weaving,* that are derived from the animal . . . . *kingdom,* perhaps the most expensive is . . . . *silk.* Of the cities of . . . . . *Europe,* that most . . . . *celebrated,* for the . . . . . *manufacture,* of . . . . *brocaded silk,* was . . . . *Lyons,* at the . . . . *confluence,* of . . . . *the Rhone and Saone,* in southern . . . . *France.* Here a loom was . . . . *invented,* by a man named . . . . *Jacquard,* and called from him the . . . . *Jacquard loom,* which obviated the necessity of employing . . . . . *children.* But by the ignorance of the . . . . . *silk-weavers,* the first Jacquard loom was forcibly taken and . . . . *burnt.*

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LESSON XLVI.

ASTRONOMY—THE SOLAR SYSTEM: ASTEROIDS: ORBITS.

The sun and the planets that revolve . . . . *round it,* are called by a name which I will place on the blackboard.

The Solar System. Let me hear it from all . . . . *The Solar System.* Solar means "belonging to the sun," and this system of worlds is called the . . . . . *Solar system,* because they . . . . *revolve round the Sun.* The planet on which we . . . . *live,* is called . . . . *the Earth.* Between it and the Sun are . . . . *two planets,* the first of which is . . . . *Mercury,* and the second . . . . *Venus.* (See Lesson xxiv. and xxviii.) They are at a less distance from . . . . *the Sun,* than . . . . *the Earth,* and are therefore called . . . . *inferior planets.*

Then after passing the Earth, we find those that are called . . . . *superior.* The first of them, which is fourth in order from . . . . *the Sun,* is called . . . . *Mars;* the fifth is . . . . *Jupiter*—it is the largest of the . . . . *planets;* sixth is . . . . *Saturn;* seventh . . . . *Herschel,* which was called after its . . . . *discoverer;* and the eighth, which is the last of the . . . . *planets,* is . . . . *Neptune.*

Now I suppose that you imagine that these planets are all at regular distances from each other. And those who think so are correct. Their distances apart are regulated by a fixed law. The distance gradually increases from each planet to the next beyond it. But during the course of observation it was found that the distance between Mars and the next beyond it, that is . . . . *Jupiter,* was twice as great as it should be to conform to this law. But no astronomer was able for a long time to find in this space any . . . . *planet.* But at last an astronomer named Piazza discovered a very small . . . . *planet,* in this region. It was so small that it excited much curiosity. Consequently observers were all on the look-out, and in another year, another astronomer named Olbers discovered another. Then was found two . . . . *others.* In a few years, a great number were found, all in this space between . . . . *Mars and Jupiter.* We now know of above one hundred of these small planets. They are called asteroids. I wish to hear this word from all . . . . *Asteroids.* The asteroids revolve round the . . . . *Sun,* as the other . . . . *planets do,* and as we have just said are found between . . . . *Mars and Jupiter.*

Now, does it not seem strange to see so many very small planets where there should only be one? How do you account for this? Well, Sam, what have you to say? .... *Perhaps it was only one planet once, and was blown to pieces.* Well done, Sam. That is what the most celebrated astronomers think. I will tell you that some of these planets which are called .... *asteroids*, are so small that a man could jump up to a distance of sixty feet from the surface, if he could stand on one of them? On our earth, the attraction of ..... *gravitation* (See Lesson XXXVII.) is so .... *powerful*, that a man could not jump up more than two or three .... *feet*, from .... *the ground.* But there are asteroids so .... *small*, that the attraction of .... *gravitation*, on them becomes very slight. It becomes so .... *slight*, that we could jump up ..... *sixty feet*, from ..... *the ground.* A western farmer could almost cultivate the whole surface of one of them if there is a proportionate amount of water surface to that which we have on .... *the earth.*

The last point to which I call attention is this: When a ship sails through the water do you think she leaves such a track behind her that another could follow her next day? .... *No, sir.* She leaves no .... *track*, or .... *path.* So you have heard of the "trackless ocean." Now, do you think that a planet leaves any path as it revolves round the Sun? .... *No, sir.* But you can imagine one. And the imaginary path which a planet follows in revolving round .... *the Sun*, is called its ....? It is its ORBIT. What is the orbit of a planet, Bessie? ..... *A planet's orbit is the imaginary path that it makes in going round the Sun.*

Now let us review. Between .... *Mars and Jupiter*, we find a greater ..... *distance*, than that which we would expect, judging from ..... *the distance of the other planets.* In this .... *space*, we find a number of small .... *planets*, called .... *asteroids.* They number nearly .... *one hundred.* They are supposed to be fragments of a larger .... *planet*, which has been .... *blown to pieces.* We have also noticed that the imaginary .... *path*, of .... *a planet*, in its .... *revolution*, round .... *the Sun*, is called ..... *its orbit.*

LESSON XLVII.

THE ARTS: REDUCTION OF METALS FROM THEIR ORES.

You can all doubtless tell me the name which is given to such substances as iron, copper, tin, lead, zinc, etc. Raise hands all who know it. Annie? .... *Metals.* What about them? .... *Iron, copper, tin, lead and zinc, are called metals.* Who can mention others? Henry? .... *Brass is a metal.* Well, it is a combination of several .... *metals.* Kate? .... *Silver and gold are metals.* Yes. George? .... *Quicksilver is a metal.* Is it in any way different to the others? .... *Yes, sir; it is a liquid metal.*

Now can any one tell me where we obtain metals? Are they in the form of metals when they are found? .... *They are found in the ground.* Yes, that is true, but do people find iron all ready made for use? I see you cannot now tell. Let us investigate the matter from what you already know. When we allow a piece of steel or iron, such as an axe or a saw, to remain outside exposed to the weather for several weeks, we find it at last all covered over with what we call .... *rust.* Repeat this, Eugene. (He repeats.) Now, what is rust? Hands up. Does no one know? You know the name of the principal gas in the atmosphere. It is .... *oxygen.* In explaining the nature of flame (See Lesson XXI.) we said that fire is caused by the .... *union,* or .... *combination,* of this .... *oxygen,* with the substance which .... *burns.* Now, rusting of metals is a species of burning. The metal combines with .... *oxygen,* and forms what we call .... *rust.* Then RUST is merely some metal combined with .... *oxygen.* Willie, you may now state to the school what IRON rust is .... *Iron rust is iron combined with oxygen.* Bessie, what is zinc rust? .... *Zinc rust is zinc combined with oxygen.* (Ask for other similar cases.)

Now I will inform you that iron and the other useful .... *metals,* are always found in this .... *condition,* or .... *state;* that is, combined with .... *oxygen,* or some similar .... *substance.* When the iron is in combination with oxygen it is called OXIDE OF IRON. What would you call lead and oxygen in combination? George? . . . . *Lead and oxygen would form oxide of lead.* And so it would also be with other . . . . *metals.*

Well, the iron, zinc, lead and other . . . . *metals*, having been exposed to the weather, and especially exposed to the . . . . . *oxygen*, have all changed to . . . . . *rust*, or . . . . .? The other word that I just now wrote on the board was . . . . *oxide.* We mean by this, Harry, that these metals . . . . *have combined with oxygen.* But we sometimes find them combined with other . . . . . *substances*, such as CARBONIC ACID. This gas, when combined with iron, forms CARBONATE OF IRON, which is very much like oxide of iron. (Ask for this statement.)

I will now try whether you can answer another question. If I were to find a quantity of oxide of iron somewhere on the ground, how could I contrive to extract the iron from the rust? You tell me that the rust consists of . . . . *iron and oxygen.* Now how could I expel the oxygen and retain the iron? Well, Eddie? . . . . *By heating it.* But I will inform you, Eddie, that heating it, alone, no matter how strongly, would not do. This would only tend to keep it more firmly in the condition of rust. When a blacksmith heats a piece of iron until it becomes . . . . *red*, or even . . . . *white*, small scales of this substance . . . . *rust*, continually drop off while he hammers it. While the iron is . . . . *hot*, it very readily combines with . . . . *oxygen*, of the . . . . *air.* The hotter it is, the more readily will it . . . . *combine.* Now if we keep on making the rust hotter, do you think it would ever change back to iron? . . . . *No, sir.* No, because this is the very best means of changing the iron into . . . . *rust;* and if even a particle were to become iron again, in the intense . . . . . *heat*, it would immediately again combine with . . . . *oxygen*, and form . . . . *rust.* But it could not, under these conditions, change back again into . . . . *iron.*

Now what do you think of this, Eddie? It is quite evident that this will not . . . . . *do.* Your answer, however, was good, as it indicated attention. Has any one a different view? Well, I will allow you all to investigate this until we have another lesson on the subject. (Here review the former part of the lesson.)

LESSON XLVIII.

NATURAL SCIENCE: TRADE WINDS.

We stated in our lesson on wind (See Lesson xxv.) that it is caused in the following way: The air at the earth's .... *surface*, becomes .... *heated*, and consequently .... *expanded*. When expanded, since it occupies more .... *space*, it becomes much .... *lighter*, and therefore .... *rises;* at the same time the surrounding .... *air*, rushes in to .... *supply its place*. (Use gestures here.)

Now, from what you know of climate, where would you expect this cause to affect the air most? George? ..... *At the Equator it would affect it most.* Correct. Those countries that lie between the Tropics of Cancer and .... *Capricorn*, are called .... *intertropical.* In intertropical ..... *countries*, the heated air is continually ..... *rising*, to the upper regions of the .... *atmosphere.*

Now, all may raise hands who can tell me how its place is supplied. Willard? .... *The cooler air of the temperate regions rushes in and takes the place of that which ascends.* Very good. We can now pass on to our next point.

One of the earth's motions is round its own .... *axis.* It rotates on its .... *axis*, once in .... *twenty-four hours.* Now I want you to listen carefully to my next question. (If you have a globe, illustrate it.) If we take one point anywhere at the Equator, and a second point say one mile from the North Pole, which point moves the faster of the two? Angus? Be careful how you answer? .... *The first point moves the more rapidly.* Why do you think so, Angus? Never make a statement unless you have a reason for it. .... *The first point goes 25,000 miles in 24 hours, while the second one goes only about three miles in the same time; therefore the first must move more rapidly.* Then you would conclude that the farther we go from the Equator, the more ..... *slowly*, does each point ..... *move.* Bessie, repeat this. (She does so.)

And, in the next place, since the air moves around with the land or water on which it .... *rests*, the particles of air towards the poles will move more slowly than those near ..... *the Equator.* For this reason, the air which rushes in from the temperate regions, when it comes near the .... *Equator*, must be left .... *behind.* People living near the .... *Equator*, therefore, would find the air moving back in a direction opposite to that in which the earth is ..... *rotating.*

Who can tell me the direction in which the earth rotates? I will tell you. It rotates FROM WEST TO EAST. The sun appears to move from .... *East to West*, on account of the earth's motion being .... *from West to East.* A point, then, at the equator, moves towards .... *the East;* and if the air coming from .... *the temperate regions*, is left ..... *behind*, it will be moving over the surface, apparently, from East to West. Or, a man at the .... *Equator*, would say that the wind was blowing from .... *the East.* This wind, at the equator, blowing from .... *East to West*, receives the name of TRADE WIND. It probably receives this name because it is so advantageous to .... *trade*, or ..... *commerce.* (Now call on different individuals to state what trade winds are, where they blow, and their causes.)

In consequence of these .... *trade winds*, which blow from .... *East to West*, in the regions on each side of .... *the Equator*, a ship leaving this city in Mexico, called .... *Acapulco* (point it out on the map of the World,) can sail completely across ..... *the Pacific Ocean*, to the continent of .... *Asia*, with a fair wind all the way. Well, Sam, I see your hand raised, what is it? .... *I can't see how the ship can get back again, if it is always blowing from East to West.* Well, this shows me that we have one boy, at least, who THINKS. Can any one tell Sam how the ship would return? As there are no hands raised I will tell you, Sam. The navigator is aware of the fact that at some distance north of the Tropic of ..... *Cancer* (point to it), these winds, which we call .... *trade winds*, do not prevail, or do not ..... *blow.* Other VARIABLE WINDS blow here, and ships returning to .... *America*, do not sail in the region of the .... *trade winds*, but return by sailing farther ..... *North.* ....

We will continue our lesson on Winds at some other time, and will then find some strange and interesting facts. We will now review our lesson. (Here rapidly review.)

LESSON XLIX.

CHEMISTRY: GENERATION OF CARBONIC ACID.

You are all satisfied that those who do not give their best . . . . . *attention,* cannot . . . . . *learn,* or . . . . . *answer.* Then you may all prepare to give your attention by sitting in the proper . . . . *position,* and looking this . . . . *way.*

Raise hands all who can remember how we proved that wood is made of various kinds of matter. Robbie? . . . . *We proved it by analysis.* Right. We analyzed the . . . . *wood,* by means of . . . . *heat;* that is, we separated it into the different . . . . *substances,* of which it is . . . . *composed,* or . . . . *made up.* We proved in this way that it is . . . . *compound.*

We also referred in the same lesson (See Lesson XLIII.) to limestone. Those who remember whether it is simple or compound may raise hands. Sarah? . . . . *Compound.* At first you thought it was . . . . *simple,* or made up of only . . . . *one kind of matter.* I told you, however, that it is . . . . *compound.* We will now describe it.

Raise hands all who have ever seen lime. How is it made? Angus? . . . . *Limestone is burned in a kiln for some hours, and when taken out is found to be lime.* Your answer is good. Now I wish to ask you what changes the limestone to lime? . . . . *The heat.* How? Do you remember our lesson on Acids, Bases and Salts? (See Lesson XLIII.) Henry? . . . . *By driving off the carbonic acid into the air.* Yes, limestone is composed of two . . . . *substances,* which are . . . . *lime and carbonic acid gas.* And by heating it in a . . . . *kiln,* the carbonic acid gas is . . . . *driven off,* or . . . . *expelled,* and therefore nothing but the lime . . . . *remains visible* [illegible]

I am now prepared to show you another mode of producing this gas from limestone. The lime, you say, is combined or . . . . *united*, with the . . . . *carbonic acid*. They like each other, apparently, very . . . . *much;* or they are said to have a very strong AFFINITY for each other. Repeat my statement, Ella? . . . . *Lime and carbonic acid have a strong affinity for each other.* Now, if I can place with limestone some substance which likes the lime better than it is liked by the . . . . *carbonic acid*, with which it is already . . . . *combined;* we repeat, if we can find some other . . . . *substance*, that has more or greater . . . . ? What word did I use just now? Here we have it on the blackboard . . . . . *affinity*, for the . . . . *lime*, than . . . . *the carbonic acid has*, this substance, you would expect, would instantly unite or . . . . *combine*, with the . . . . *lime*, and allow the . . . . *carbonic acid*, to . . . . *escape*, or . . . . *go free*.

Let us further illustrate. Charlie and Harry are firm and steadfast friends. They are always in company. On some fine day they walk down the street. As they pass a certain point, Frank, one of Charlie's old friends, whom he knew in the East ten years before, is observed coming up the other side of . . . . *the street*. Now raise hands those who think they know what would happen. John? . . . . *Charlie would leave Harry, and run over to meet Frank.* Very good. And now let us make our statement again about the . . . . . *limestone*. It consists of . . . . *lime*, and *carbonic acid;* if, however, we introduce some other . . . . *substance*, which the lime prefers to the . . . . *carbonic acid*, at once the lime leaves the . . . . *carbonic acid*, to unite with this new . . . . *substance*, and the carbonic acid being a gas, escapes into . . . . *the air*. The new substance introduced I will here tell you, is called HYDROCHLORIC ACID. James, you may now describe this process again. (He does so. Do not leave it till all can.)

(Procure a glass jar with a neck from one to two inches in diameter. Fit a cork to the neck. Perforate the cork, and pass through it a glass tube that exactly fits in the orifice. Bend the tube in the flame of a spirit lamp so as to make it lead downwards. Now place some pieces of limestone, or marble, in the jar, and pour upon it about a tablespoonful of hydrochloric acid diluted with twice as much water. Then insert the cork and tube. The carbonic acid, after all the common air in the glass is expelled, will issue abundantly. It is so heavy that it can be collected in glass or other vessels, such as tumblers, at the extremity of the tube. It can even be poured from one glass to another. A candle-flame may be extinguished by pouring it gently from a glass upon the flame. A lighted candle attached to a wire and lowered into a glass of carbonic acid is immediately extinguished.)

Now let us revise. We have just described another process for generating or . . . . *producing*, the gas which is contained in . . . . *limestone*, which is . . . . *carbonic acid.* We introduce some . . . . . *substance*, which likes the . . . . . *lime*, better than . . . . *the carbonic acid does.* This substance is . . . . *hydrochloric acid.* It combines with the . . . . *lime*, and allows . . . . . *the carbonic acid to escape;* it passes out through this bent . . . . *tube.*

LESSON L.

NATURAL SCIENCE—LIGHT AND HEAT: REFRACTION, REFLECTION AND ABSORPTION.

You will all remember that we named three things in Nature that are considered to have no weight. They are said to be . . . . . *imponderable.* What are they? Harry? . . . . . *Light, Heat, and Electricity.* (See Lesson XXIX.) What about them? Annie? . . . . *They are the three imponderable bodies of Nature.* Raise hands all who will make the complete statement. Ella? (She makes it.)

Now our principal source of light and heat is . . . . . *the sun.* The sun sends off or . . . . . *emits*, its . . . . . *light and heat*, in straight lines called . . . . . *rays.* The word which means "to send off in rays" is . . . . . *radiate.* Frank, you may state this again . . . . *The sun radiates its light and heat.*

We are now prepared to extend this subject further. When the rays of . . . . *light*, or . . . . *heat*, pass off from any source such as . . . . *the sun*, you can see that they will proceed in their course until they are interrupted. Repeat this, Eddie. (He repeats.) Well, in what ways may they be interrupted? I will tell you. They are interrupted by meeting objects. When a ray meets an . . . . . *object*, it is . . . . . *interrupted*, that is, its progress is interfered with. This is done in three different ways that we will now proceed to consider.

When a ray of light or heat comes in contact with any object, three things may happen to it. What are they? All think carefully. Let me direct your thoughts. When the rays of light from a lamp-flame strike the glass . . . . . *chimney*, what becomes of them? Do they stop there? . . . . *No, sir. They pass through.* Do they pass through anything besides the glass? Sam? . . . . *They pass through the air.* That is correct. We have now taken one step. There is a name given to a substance that will allow rays to pass through it. Raise hands those who can give it. I will write it. It is called a MEDIUM. What is a medium? George? (He states it.)

The air, then, is . . . . *a medium*, for the rays of . . . . *light or heat.* So also is . . . . . *glass;* that is, these substances allow rays to . . . . *pass through them.* Do you know of any others? Fannie? . . . . . *Is water a medium?* I will ask all who think it is to raise hands. Can you see through water? I see nearly all hands raised. Water is . . . . . *a medium.* Now, water is thinner than glass, and air is thinner than . . . . . *water.* Then if air is thinner than water, the water, when compared with the air, is more . . . . ? When speaking of the air, we said that in the upper regions it is very . . . . *rare*, and at the earth's surface it is . . . . *dense.* We now wish to use these two words. Air is thinner or . . . . *rarer*, than . . . . . *water;* and the water would be, on the other hand, more . . . . *dense than air.* Of the three, glass, water, and air, the glass is . . . . . *densest*, and the air . . . . *the rarest.*

Now I will tell you that when a ray passes from a rare . . . . . *medium*, into a . . . . . *dense one*, IT IS BENT TOWARDS

THE DENSE ONE. But the word that is used instead of bent is REFRACTED. The rays are .... *refracted*, or .... *bent*, towards the ..... *dense medium*, when they pass into it from a .... *rarer one.* And this bending of the rays is called REFRACTION. Emily you may now tell me what refraction means.

But a piece of iron would not be a ..... *medium;* it would not allow the rays ..... *to pass through it.* What then would become of them? When a rubber ball is thrown against a hard surface it ..... *rebounds.* Well, Frank? ..... *The rays would rebound.* Well, this is one thing that might happen. And I will tell you that this is called REFLECTION. When the rays strike a surface, they are sometimes .... *reflected.* Reuben, repeat this. (He repeats).

Still another effect. When a ball is thrown against a surface of water or mud, what then? Does it rebound? .... *No, sir.* What happens when water is placed about a sponge? Ella? .... *The sponge absorbs the water.* Very good. Ella has just used the word we want. I am now writing the word. ABSORPTION. Sometimes when rays strike an .... *object*, they are .... *absorbed*, and this absorbing of the rays is called .... *absorption.* A substance which is black, for instance, absorbs more heat than one which is .... *white.* Thus, in summer, it is more comfortable to wear .... *white clothes*, than .... *black.*

All now answer rapidly. When rays of ..... *light or heat*, meet an .... *object*, they are either allowed to ..... *pass through*, or are .... *reflected*, or ..... *absorbed.* The substance which allows them .... *to pass through*, is called ..... *a medium.* And when they pass from one ..... *medium*, into .... *another*, they are said to be .... *refracted.* All may repeat these three words. 1st, ... *Refraction;* 2d, ... *Reflection;* and 3d, ... *Absorption.*

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After a careful examination of Peck's Ganot's Natural Philosophy, and an actual test of its merits as a text-book, I can heartily recommend it as admirably adapted to meet the wants of the grade of students for which it is intended. Its diagrams and illustrations are *unrivaled*. We use it in the Baldwin University.

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The Natural Philosophy of M. Ganot, edited by Prof. Peck, is, in my opinion, the best work of its kind, for the use intended, ever published in this country. Whether regarded in relation to the natural order of the topics, the precision and clearness of its definitions, or the fullness and beauty of its illustrations, it is certainly, I think, an advance.

☞ For many similar testimonials, see current numbers of the Illustrated Educational Bulletin.

NATURAL SCIENCE—Continued.

CHEMISTRY.

Porter's First Book of Chemistry,	$1 00
Porter's Principles of Chemistry,	2 00

The above are widely known as the productions of one of the most eminent scientific men of America. The extreme simplicity in the method of presenting the science, while exhaustively treated, has excited universal commendation. Apparatus adequate to the performance of every experiment mentioned, may be had of the publishers for a trifling sum. The effort to popularize the science is a great success. It is now within the reach of the poorest and least capable at once.

Darby's Text-Book of Chemistry,	1 75

Purely a Chemistry, divesting the subject of matters comparatively foreign to it (such as heat, light, electricity, etc.), but usually allowed to engross too much attention in ordinary school-books.

Gregory's Organic Chemistry,	2 50
Gregory's Inorganic Chemistry,	2 50

The science exhaustively treated. For colleges and medical students.

Steele's Fourteen Weeks' Course,	1 50

A successful effort to reduce the study to the limits of a *single term*, thereby making feasible its general introduction in institutions of every character. The author's felicity of style and success in making the science pre-eminently *interesting* are peculiarly noticeable features.

Chemical	**Apparatus,**	to accompany "Porter"	20 00
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BOTANY.

Thinker's First Lessons in Botany,	40

For children. The technical terms are largely dispensed with in favor of an easy and familiar style adapted to the smallest learner.

Wood's Object Lessons in Botany,	1 50
Wood's American Botanist and Florist,	2 50
Wood's New Class-Book of Botany,	3 50

The standard text-books of the United States in this department. In style they are simple, popular, and lively; in arrangement, easy and natural; in description, graphic and strictly exact. The Tables for Analysis are reduced to a perfect system. More are annually sold than of all others combined.

Darby's Southern Botany,	2 00

Embracing general Structural and Physiological Botany, with vegetable products, and descriptions of Southern plants, and a complete Flora of the Southern States.

NATURAL SCIENCE—Continued

PHYSIOLOGY.

Jarvis' Elements of Physiology, ... $ 75

Jarvis' Physiology and Laws of Health, . 1 65

The only books extant which approach this subject with a proper view of the true object of teaching Physiology in schools, viz., that scholars may know how to take care of their own health. In bold contrast with the abstract *Anatomies*, which children learn as they would Greek or Latin (and forget as soon), to *discipline the mind*, are these text-books, using the *science* as a secondary consideration, and only so far as is necessary for the comprehension of the *laws of health*.

Hamilton's Vegetable & Animal Physiology, 1 25

The two branches of the science combined in one volume lead the student to a proper comprehension of the Analogies of Nature.

ASTRONOMY.

Steele's Fourteen Weeks' Course, ... 1 50

Reduced to a single term, and better adapted to school use than any work heretofore published. Not written for the information of scientific men, but for the inspiration of youth, the pages are not burdened with a multitude of figures which no memory could possibly retain. The whole subject is presented in a clear and concise form.

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Bartlett's Spherical Astronomy, ... 5 00

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Carl's Child's Book of Natural History, . . 0 50

Illustrating the Animal, Vegetable, and Mineral Kingdoms, with application to the Arts. For beginners. Beautifully and copiously illustrated.

ZOOLOGY.

Chambers' Elements of Zoology, ... 1 50

A complete and comprehensive system of Zoology, adapted for academic instruction, presenting a systematic view of the Animal Kingdom as a portion of external Nature.

Jarvis' Physiology and Laws of Health.

TESTIMONIALS.

From SAMUEL B. MCLANE, *Superintendent Public Schools, Keokuk, Iowa.*

I am glad to see a really good text-book on this much neglected branch. This is clear, concise, accurate, and eminently adapted to the *class-room.*

From WILLIAM F. WYERS, *Principal of Academy, West Chester, Pennsylvania.*

A thorough examination has satisfied me of its superior claims as a text-book to the attention of teacher and taught. I shall introduce it at once.

From H. R. SANFORD, *Principal of East Genesee Conference Seminary, N. Y.*

"Jarvis' Physiology" is received, and fully met our expectations. We immediately adopted it.

From ISAAC T. GOODNOW, *State Superintendent of Kansas—published in connection with the "School Law."*

"Jarvis' Physiology," a common-sense, practical work, with just enough of anatomy to understand the physiological portions. The last six pages, on Man's Responsibility for his own health, are worth the price of the book.

From D. W. STEVENS, *Superintendent Public Schools, Fall River, Mass.*

I have examined Jarvis' "Physiology and Laws of Health," which you had the kindness to send to me a short time ago. In my judgment it is far the best work of the kind within my knowledge. It has been adopted as a text-book in our public schools.

From HENRY G. DENNY, *Chairman Book Committee, Boston, Mass.*

The very excellent "Physiology" of Dr. Jarvis I had introduced into our High School, where the study had been temporarily dropped, believing it to be by far the best work of the kind that had come under my observation; indeed, the reintroduction of the study was delayed for some months, because Dr. Jarvis' book could not be had, and we were unwilling to take any other.

From PROF. A. P. PEABODY, D.D., LL.D., *Harvard University.*

* * I have been in the habit of examining school-books with great care, and I hesitate not to say that, of all the text-books on Physiology which have been given to the public, Dr. Jarvis' deserves the first place on the score of accuracy, thoroughness, method, simplicity of statement, and constant reference to topics of practical interest and utility.

From JAMES N. TOWNSEND, *Superintendent Public Schools, Hudson, N. Y.*

Every human being is appointed to take charge of his own body; and of all books written upon this subject, I know of none which will so well prepare one to do this as "Jarvis' Physiology"—that is, in so small a compass of matter. It considers the pure, simple *laws of health* paramount to science; and though the work is thoroughly scientific, it is divested of all cumbrous technicalities, and presents the subject of physical life in a manner and style really charming. It is unquestionably the best text-book on physiology I have ever seen. It is giving great satisfaction in the schools of this city, where it has been adopted as the standard.

From L. J. SANFORD, M.D., *Prof. Anatomy and Physiology in Yale College*

Books on human physiology, designed for the use of schools, are more generally a failure perhaps than are school-books on most other subjects.

The great want in this department is met, we think, in the well-written treatise of Dr. Jarvis, entitled "Physiology and Laws of Health." * * The work is not too detailed nor too expansive in any department, and is clear and concise in all. It is not burdened with an excess of anatomical description, nor rendered discursive by many zoological references. Anatomical statements are made to the extent of qualifying the student to attend, understandingly, to an exposition of those functional processes which, collectively, make up health; thus the laws of health are enunciated, and many suggestions are given which, if heeded, will tend to its preservation.

☞ For further testimony of similar character, see current numbers of the **Illustrated Educational Bulletin.**

NATURAL SCIENCE.

"FOURTEEN WEEKS" IN EACH BRANCH.

By J. DORMAN STEELE, A. M.

Steele's 14 Weeks Course in Chemistry	$1 50
Steele's 14 Weeks Course in Astronomy	1 50
Steele's 14 Weeks Course in Philosophy	1 50
Steele's 14 Weeks Course in Geology.	1 50

The unparalleled success of the first volume, "14 *Weeks in Chemistry*," encouraged the publishers to project a complete course upon a similar plan, and designed to make the Natural Sciences *popular*.

Our Text-Books in these studies are, as a general thing, dull and uninteresting. They contain from 400 to 600 pages of dry facts and unconnected details. They abound in that which the student cannot learn, much less remember. The pupil commences the study, is confused by the fine print and coarse print, and neither knowing exactly what to learn nor what to hasten over, is crowded through the single term generally assigned to each branch, and frequently comes to the close without a definite and exact idea of a single scientific principle.

Steele's Fourteen Weeks Courses contain only that which every well-informed person should know, while all that which concerns only the professional scientist is omitted. The language is clear, simple, and interesting, and the illustrations bring the subject within the range of home life and daily experience. They give such of the general principles and the prominent facts as a pupil can make familiar as household words within a single term. The type is large and open; there is no fine print to annoy; the cuts are copies of genuine experiments or natural phenomena, and are of fine execution.

In fine, by a system of condensation peculiarly his own, the author reduces each branch to the limits of a single term of study, while sacrificing nothing that is essential, and nothing that is usually retained from the study of the larger manuals in common use. Thus the student has rare opportunity to *economize his time*, or rather to employ that which he has to the best advantage.

A notable feature is the author's charming "style," fortified by an enthusiasm over his subject in which the student will not fail to partake. Believing that Natural Science is full of fascination, he has moulded it into a form that attracts the attention and kindles the enthusiasm of the pupil.

The recent editions contain the author's "Practical Questions" on a plan never before attempted in scientific text-books. These are questions as to the nature and cause of common phenomena, and are not directly answered in the text, the design being to test and promote an intelligent use of the student's knowledge of the foregoing principles.

Steele's General Key to his Works	$1 50

This work is mainly composed of Answers to the Practical Questions and Solutions of the Problems in the author's celebrated "Fourteen Weeks Courses" in the several sciences, with many hints to teachers, minor Tables, &c. Should be on every teacher's desk.

Steele's 14 Weeks in each Science.

TESTIMONIALS.

From L. A. Bikle, *President N. C. College.*

I have not been disappointed. Shall take pleasure in introducing this series.

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I am much pleased with these books, and expect to introduce them.

From J. R. Branham, *Prin. Brownsville Female College, Tenn.*

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I was prepared to find Prof. Steele's Course both attractive and instructive. My highest expectations have been fully realized.

From J. S. Blackwell, *Prest. Chent College, Ky.*

Prof. Steele's unexampled success in providing for the wants of academic classes, has led me to look forward with high anticipations to his forthcoming issue.

From J. F. Cook, *Prest. La Grange College, Mo.*

I am pleased with the neatness of these books and the delightful diction. I have been teaching for years, and have never seen a lovelier little volume than the Astronomy.

From M. W. Smith, *Prin. of High School, Morrison, Ill.*

They seem to me to be admirably adapted to the wants of a public school, containing, as they do, a sufficiently comprehensive arrangement of elementary principles to excite a healthy thirst for a more thorough knowledge of those sciences.

From J. D. Bartley, *Prin. of High School, Concord, N. H.*

They are just such books as I have looked for, viz., those of interesting style, not cumbersome and filled up with things to be omitted by the pupil, and yet sufficiently full of facts for the purpose of most scholars in these sciences in our high schools; there is nothing but what a pupil of average ability can thoroughly master.

From Alonzo Norton Lewis, *Principal of Parker Academy, Conn.*

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As an introduction to the various branches of which they treat, and especially for that numerous class of pupils who have not the time for a more extended course, I consider them *invaluable*.

From Edward Brooks, *Prin. State Normal School, Millersville, Pa.*

At the meeting of Normal School Principals, I presented the following resolution, which was unanimously adopted: "*Resolved*, That Steele's 14 Weeks Courses in Natural Philosophy and Astronomy, or an amount equivalent to what is contained in them, be adopted for use in the State Normal Schools of Pennsylvania." The works themselves will be adopted by at least three of the schools, and, I presume, by them all.

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To teach conversational French by actual practice, on an entirely new plan, which recognizes the importance of the student learning *to think* in the language which he speaks. It furnishes an extensive vocabulary of words and expressions in common use, and suffices to free the learner from the embarrassments which the peculiarities of his own tongue are likely to be to him, and to make him thoroughly familiar with the use of proper idioms.

Worman's German Echo,	1 25

On the same plan. See Worman's German Series, page 29.

Pujol's Complete French Class-Book,	2 25

Offers, in one volume, methodically arranged, a complete French course—usually embraced in series of from five to twelve books, including the bulky and expensive Lexicon. Here are Grammar, Conversation, and choice Literature—selected from the best French authors. Each branch is thoroughly handled; and the student, having diligently completed the course as prescribed, may consider himself, without further application, *au fait* in the most polite and elegant language of modern times.

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The History of the United States, translated by Professors TOLON and DE TORNOS, will be found a valuable, instructive, and entertaining reading-book for Spanish classes.

Pujol's Complete French Class-Book.

TESTIMONIALS.

From PROF. ELIAS PEISSNER, *Union College.*

I take great pleasure in recommending Pujol and Van Norman's French Class-Book, as there is no French grammar or class-book which can be compared with it in completeness, system, clearness, and general utility.

From EDWARD NORTH, *President of Hamilton College.*

I have carefully examined Pujol and Van Norman's French Class-Book, and am satisfied of its superiority, for college purposes, over any other heretofore used. We shall not fail to use it with our next class in French.

From A. CURTIS, *Pres't of Cincinnati Literary and Scientific Institute.*

I am confident that it may be made an instrument in conveying to the student, in from six months to a year, the art of speaking and writing the French with almost native fluency and propriety.

From HIRAM ORCUTT, A. M., *Prin. Glenwood and Tilden Ladies' Seminaries.*

I have used Pujol's French Grammar in my two seminaries, exclusively, for more than a year, and have no hesitation in saying that I regard it the best text-book in this department extant. And my opinion is confirmed by the testimony of Prof. F. De Launay and Mademoiselle Marindin. They assure me that the book is eminently accurate and practical, as tested in the school-room.

From PROF. THEO. F. DE FUMAT, *Hebrew Educational Institute, Memphis, Tenn.*

M. Pujol's French Grammar is one of the best and most practical works. The French language is chosen and elegant in style—modern and easy. It is far superior to the other French class-books in this country. The selection of the conversational part is very good, and will interest pupils; and being all completed in only one volume, it is especially desirable to have it introduced in our schools.

From PROF. JAMES H. WORMAN, *Bordentown Female College, N. J.*

The work is upon the same plan as the text-books for the study of French and English published in Berlin, for the study of those who have not the aid of a teacher, and these books are considered, by the first authorities, the best books. In most of our institutions, Americans teach the modern languages, and heretofore the trouble has been to give them a text-book that would dispose of the difficulties of the French pronunciation. This difficulty is successfully removed by P. and Van N., and I have every reason to believe it will soon make its way into most of our best schools.

From PROF. CHARLES S. DOD, *Ann Smith Academy, Lexington, Va.*

I cannot do better than to recommend "Pujol and Van Norman." For comprehensive and systematic arrangement, progressive and thorough development of all grammatical principles and idioms, with a due admixture of theoretical knowledge and practical exercise, I regard it as superior to any (other) book of the kind.

From A. A. FORSTER, *Prin. Pinehurst School, Toronto, C. W.*

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☞ **For further testimony of a similar character, see special circular, and current numbers of the Educational Bulletin.**

GERMAN.

A COMPLETE COURSE IN THE GERMAN.

By JAMES H. WORMAN, A. M.

Worman's Elementary German Grammar . $1 50
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The finest compilation of classical and standard German Literature ever offered to American students. It embraces, progressively arranged, selections from the masterpieces of Goethe, Schiller, Korner, Seume, Uhland, Freiligrath, Heine, Schlegel, Holty, Lenau, Wieland, Herder, Lessing, Kant, Fichte, Schelling, Winkelmann, Humboldt, Ranke, Raumer, Menzel, Gervinus, &c., and contains complete Goethe's "Iphigenie," Schiller's "Jungfrau;" also, for instruction in modern conversational German, Benedix's "Eigensinn."

There are besides, Biographical Sketches of each author contributing, Notes, explanatory and philological (after the text), Grammatical References to all leading grammars, as well as the editor's own, and an adequate Vocabulary.

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Consists of exercises in colloquial style entirely in the German, with an adequate vocabulary, not only of words but of idioms. The object of the system developed in this work (and its companion volume in the French) is to break up the laborious and tedious habit of *translating the thoughts*, which is the student's most effectual bar to fluent conversation, and to lead him to *think in the language in which he speaks*. As the exercises illustrate scenes in actual life, a considerable knowledge of the manners and customs of the German people is also acquired from the use of this manual.

Worman's German Grammars.

TESTIMONIALS.

From Prof. R. W. Jones, *Petersburg Female College, Va.*

From what I have seen of the work it is almost certain *I shall introduce it* into this institution.

From Prof. G. Campbell, *University of Minnesota.*

A valuable addition to our school-books, and will find many friends, and do great good.

From Prof. O. H P. Corprew, *Mary Military Inst*, *Md.*

I am better pleased with them than any I have ever taught. I have already ordered through our booksellers.

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I have examined the Complete Grammar, and find it *excellent.* You may rely that it will be used here.

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The Complete German Grammar is worthy of an extensive circulation. It is *admirably adapted* to the class-room. I shall use it.

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From Prin. Silas Livermore, *Bloomfield Seminary, Mo.*

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[From the New York Pathfinder, Aug. 1866.]

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